Chemical Engineering

DECEMBER 1954

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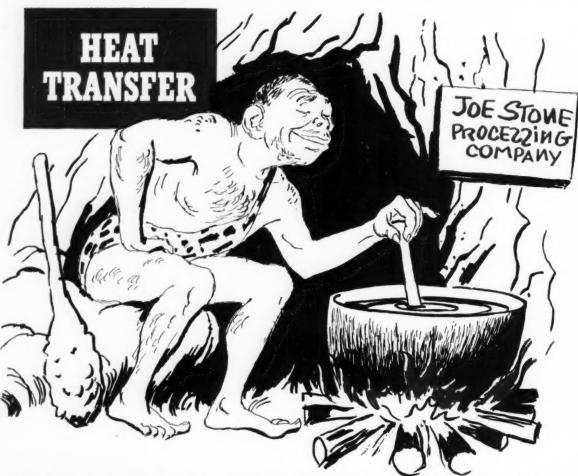
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CONTINUOUS? EFFICIENT? ECONOMICAL?

Read how you can save the modern way

NO DOUBT you've seen some batch processing methods in use today which basically are not a far cry from that used by Joe Stone, above. What a contrast to the high-speed, efficient, continuous processing afforded by VOTATOR* Heat-transfer Apparatus for liquids and viscous materials!

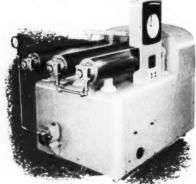
Scraped surface action and the violent intermixing within the heat transfer zone provides intimate contact between any reacting materials as well as maximum contact of the feed materials and the heat transfer surface. The heat transfer rates are six to ten times faster than those of conventional batch methods. Over-all heat transfer coefficients of 200-500 Btu per hour per square foot per °F. are normally obtained. A wide range of processing temperatures . . . from below -100°F. to above 600°F. . . . is possible by selection of heat transfer medium such as . . . ammonia, Freon, brine, propane, water, ethylene, steam or Dowtherm.

Whether your process calls for heating, cooling, plasticizing, emulsifying, or crys-

tallizing, extruding, chemical reactions or aerating, VOTATOR Heat-transfer Apparatus does the job speedily, uniformly and efficiently. Units are available with heat transfer areas ranging from 0.7 to 60 square feet and capable of delivering from 100 to 30,000 pounds of finished product per hour. They are made in metals and alloys to suit your application.

Find out how this automatic, closedsystem processing equipment can improve your products and cut your costs. Write for free 32-page booklet on continuous processing. The Girdler Company, Votator Division, Louisville 1, Kentucky.

SVOTATOR-Trade-mark Reg. U. S. Pat. Off.

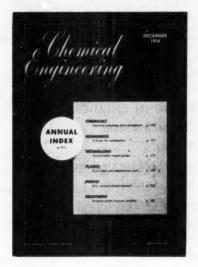


The GIRDLER Company

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VOTATOR DIVISION: New York, Atlanta, Chicago, San Francisco



We Need Your Ideas

Over two months ago you received your copy of CE's 1st Annual Inventory Issue—a special 13th issue designed to fill your needs for an "inventory" reference that can be used throughout the year.

What do you think of it now that you've looked it over closely? Does it fill the bill?

Have you used it yet? If so, how? Did you find what you were looking for? Did you find it fast, without any trouble? Do you expect to use this Inventory issue throughout the year?

These are the things we'd like to know. For they will guide us to improvements that will help make this reference even more useful to you and to chemical engineers everywhere.

Just drop us a letter, a note, anything that'll let us know how you like your Inventory Issue, how you're using it, how you think we can improve it.

We appreciate your help in guiding us toward a better job.-JRC

How new depreciation methods change your cost estimating procedures.

Here's a timely run-down of the seven ways you can now figure depreciation allowance. Most of them are brand new. But they're all important to engineers—especially to those in cost estimating work—for new rules allow a faster writeoff in the early years of a plant's useful life. The authors give specific examples and a dollar-and-cents tally of how the seven methods stack up. (p. 171)



Fresh approach to solids flow.

New experimental work points to a novel theory of bulk solids flow, a quantitative approach to equipment design, development of a "flow factor." A basic look at a basic problem. (p. 175)



How to design gas-cooling towers.

A new graphical method makes the job reliable. It'll help when you have to grapple with simultaneous heat fransfer, humidifica-



Please turn page



tion and dehumidification. Gives design factors and theory. (p. 191)



Use this chart for vapor viscosities.

You'll find it a lot easier to estimate viscosities of single component vapors and mixtures of vapors. It's based on vapor temperature, molecular weight, critical temperature and pressure. (p. 195)



Practical finned tube design.

There're many shapes and sizes of finned tube heat exchangers—but only one practical way for you to determine their heat transfer coefficients. Here's that method—with how-to-details. (p. 182)



Today's new look in maintenance.

It's "engineered" maintenance, and it shows how to exploit this last frontier of cost reduction in chemical plants. Helpful information on organization, principles, shops and tools, costs. (p. 187)



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Chemical Engineering

CHEMENTATOR.....



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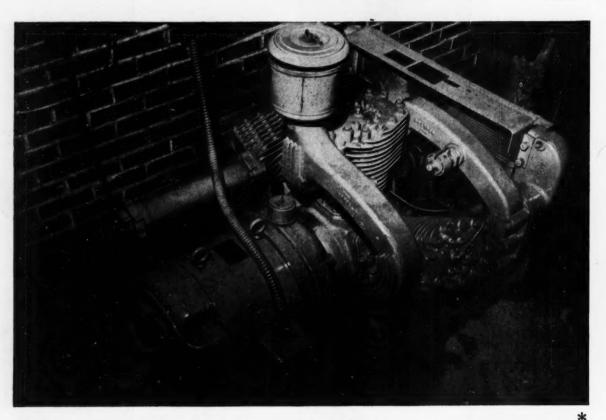
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 psi, standard.
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 units to 250 psi).
- Single or two stage.
- · Air cooled.
- Force-feed lubrication.
- Eleven models.

... And, you have your choice of drives: Direct, V-Belt, Flange-Mounted. In fact, these compressors are available as packaged units, like that shown at the left, delivered complete with air receivers, piping and wiring.

Get full details by writing for Bulletin A-56. • Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.







If you are the average cooling tower owner, you do not test your purchase. In fact, Mr. Average Owner knows less about the actual performance of his cooling tower than his wife does about the interior of the melon to which she has applied the "squeeze and sniff" test. True, cooling towers are purchased for a specified performance; but the difference between "specified" and "actual" is sometimes astounding and only a test will tell.

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method by which you can test your industrial cooling tower and arrive at positive results. By applying this test you know whether or not your "guaranteed" tower does the job it was specified for.

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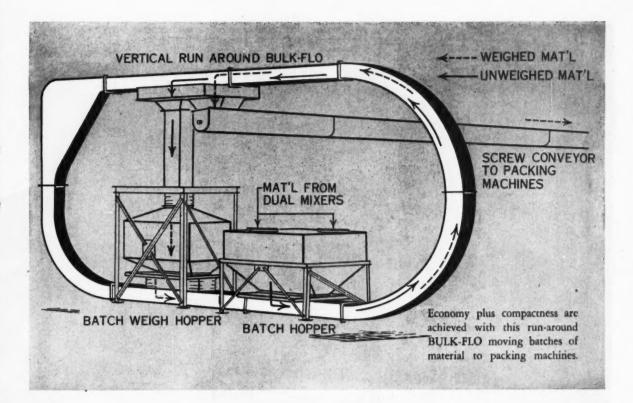
WELDCO Type 430-T Welded Stainless Steel Tubing was used in the tank muffler shown above. It was chosen for ALL the tubular parts because it met the heavy-duty requirements of this application. Firestone Steel Products Co., Akron, Ohio, specified WELDCO Tubing because of its exclusive Double-Fusion Weld and excellent fabricating qualities,

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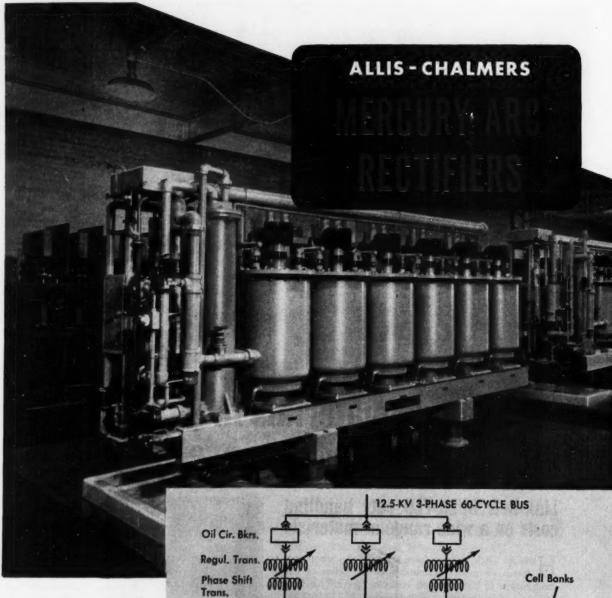
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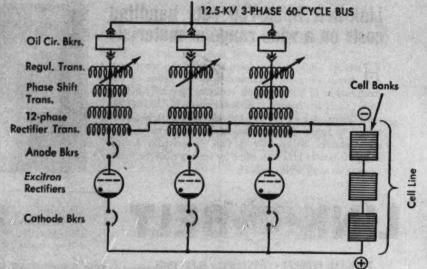
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RECTIFIER ROOM SHOWS

the three rectifiers used in this 10,000-kw, 600-volt installation. Each rectifier has 12 tubes, permitting 36-phase plant operation. Because complete loss of power supply, even for a short time, may seriously disturb the electrolytic process, provision has been made to transfer to plant supply in case of outside power failure.



SCHEMATIC DIAGRAM SHOWS simplified system layout, which eliminates unnecessary components, reduces cost. Phase control provides for gradual drop of load. No breakers operate during cell bank switching.

How Phase Control of Rectifiers Cuts Time & Cost of Automatic Cell Bank Switching

AT A SOUTHWESTERN ELECTROLYTIC ZINC PLANT, cell bank switching is made fast and simple through use of phase control on mercury arc rectifiers. Electrodes in the zinc cells must be stripped daily.

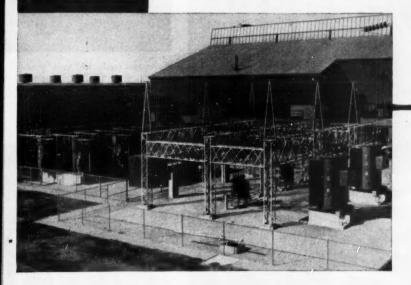
The extreme high accuracy of firing with Allis-Chalmers excitron rectifiers permits the necessary switching to be done with phase control. By operating a phase control switch in the cell room, the cell lines can be unloaded. Then, a bank of cells is isolated for stripping, and a spare cell bank, previously stripped, is substituted. Normal load operation is resumed by operating the phase control switch. No

power breakers need be opened. The coraplete operation takes but a few minutes.

Three features of Allis-Chalmers mercury arc rectifiers assure successful operation with phase control. Continuous excitation — pilot arcs always present — eliminates the need for reignition every cycle, thus makes rectifiers less sensitive to supply voltage dips. The design of grid control system provides highly accurate control of rectifier firing. Finally, cooling of rectifiers by means of internal seamless steel coils assures proper distribution of mercury vapor for best operation at all loads.

These features in addition to advanced application engineering may help cut costs on your next rectifier installation. Get complete information from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4423

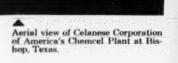


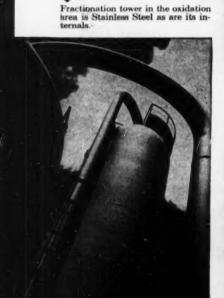
EXCEPTIONALLY FLEXIBLE AUTO-MATIC LOAD CONTROL of this installation is provided by a combination of steptype regulating transformers with phase control, which assures close cell current regulation with maximum power factor.

ALLIS-CHALMERS

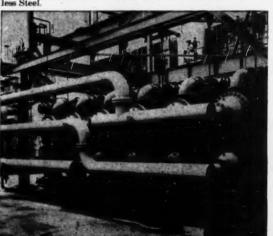
ACC ALLIS CHALARES

Stainless Steel has two



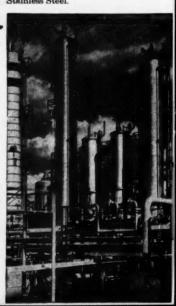


Heat exchangers, heads and pipes in oxidation area, also Stainless Steel.



In the acetic acid unit, most towers, tower internals and heat exchangers are Stainless Steel.

Formaldehyde unit at the Chemcel Plant, with towers and internals of Stainless Steel.



big jobs in this plant

... RESISTING CORROSION'S ATTACK

... PROTECTING PRODUCT PURITY

This is the Chemcel Plant of Celanese Corporation of America at Bishop, Texas. Like so many other plants of its nature, it depends heavily on Stainless Steel to keep its operations continually on stream.

The fractionation tower and its internals, located in the oxidation area, are made of Stainless Steel. So are the heat exchangers, heads and pipes in this same reaction area.

Similar applications of Stainless Steel are located in the secondary oxidation or acetic acid unit and in the formaldehyde unit.

In each case, Stainless Steel is doing a dual job. It is used to withstand the attack of the highly corrosive products being handled, and it safeguards the purity of the chemicals being processed.

Along with these primary advantages of Stainless Steel in petrochemical processing go lower maintenance and replacement costs due to Stainless Steel's durability and long life. It will pay you to put Stainless Steel's benefits to work for you, and when you do be sure it is perfected service-tested USS Stainless Steel.



Process Equip

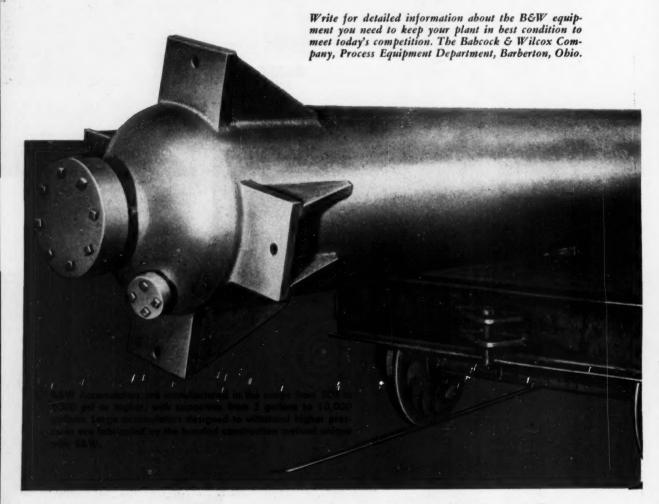
that meets TODAY'S

B&W Accumulators and other Pressure Vessels
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The constant progress being made within the process industries demands the utmost of the engineers responsible for the dependability, efficiency and economy of the equipment that serves today's process industries' requirements.

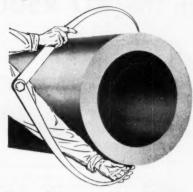
At B&W, forming, machining, welding,

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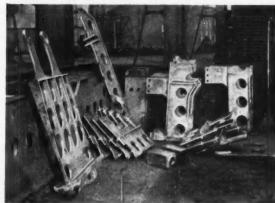
requirements



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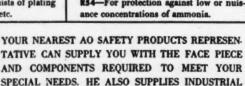
R54-For protection against low or nuis-



R50-For combination of all dusts, toxic, pneumoconiosis-producing, nuisance. B. M. 2156.



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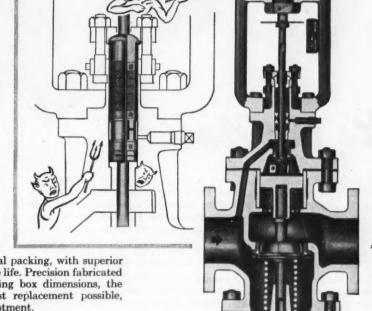
PACKING PROBLEMS?

The new Leslie Lubrisoft® Packing now standard in all Leslie Diaphragm Control Valves is recommended for valve body temperatures up to 500° F. without external lubrication. When used with the Leslie thermo-isolating bonnet, it may be used for valve body temperatures up to 1050° F., eliminating need for external lubricators and isolating valves in most applications.

LESLIE LUBRISOFT® PACKING "BEATS THE DEVIL" OUT OF ALL 8 MOVING STEM SEAL PROBLEMS

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- 3. Corrosion
- 4. Electrolytic Action
- 5. Oxidation
- 6. Extrusion
- 7. Abrasion
- 8. Friction



Overall result is a standard, economical packing, with superior stem sealing properties and long service life. Precision fabricated to conform exactly to the deep stuffing box dimensions, the positive, split ring design makes fast replacement possible, without disturbing body or stem adjustment.

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LESLIE CONTROL VALVES

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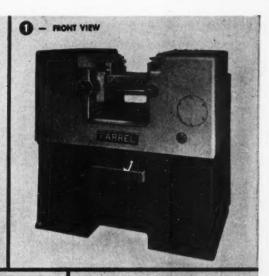
No internal wearing parts. No valves, pistons, or vanes. No internal lubrication. Low maintenance cost. Saves floor space. Desired delivery temperature Automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
312 WILSON, SO. NORWALK, CONN.

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0	Vari-pitch Pulley
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0	Variable Voltage

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(AC)	715	1.4:1
(AC)	7%	1.41
(AC)	5	Variable
(DC)	5	Variable

Roll Spee	d (RPM) Back
23.5	33
13 to 24	18 to 34
20 to 38	18 to 34
4.5 to 34	6 to 45

Here is a standard, two-roll, 6" x 13" laboratory mill, which you can have with four different drive arrangements. One of these should give you exactly the roll speed, or speeds, and friction ratio you need for your experimental work.

Drive may be (1) by single AC motor with mill gearing to give constant roll speed and 1.4:1 friction; (2) by single AC motor driving the rolls through vari-speed sheaves to give a back roll speed range of 18 to 34 RPM and 1.4:1 friction; (3) by two AC motors with vari-speed drives for friction ratios from even speed up to 2.1:1; (4) by two DC motors with variable voltage control for ratios from even speed up to 10:1 friction.

Standard mills have self-contained automatic cascade lubrication, swinging scraper, tilting guides and knee-operated safety trip. Optional features include chrome-plated rolls, extra hand scraper, air-operated scraper, ratchet roll adjustment, and batch-off roll.

Send for further information about this versatile mill. Or, if you prefer, a Farrel-Birmingham engineer will be glad to discuss your laboratory equipment problems with you at any time.

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Significant is the fact that CHEMICO's 1,000th project is a repeat order . . . the third order from the same client.

This project is a contact sulfuric acid plant for a Brazilian company which placed its first order with CHEMICO eighteen years ago.

Repeat orders mean satisfied customers . . . and the list of CHEMICO's 1,000 projects includes an impressive volume of such business. Whatever may be your needs for the manufacture of heavy chemicals, be sure to consult CHEMICO.

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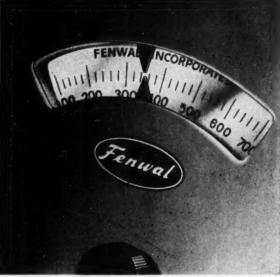
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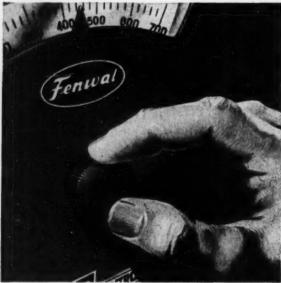
Now . . . a new Temperature Indicator-Controller by Fenwal



1. FENWAL'S NEW SERIES 540 is a remote Temperature Indicator-Controller that combines low cost with high accuracy over a temperature range of 100° to 700°F. Designed for ovens, packaging and processing equipment of all types, the new controller operates on a liquid-filled bulb and capillary system whose response to temperature changes is transmitted through a bellows to an indicating pointer. It may be flush-mounted or surface-mounted.



2. "SET" AND "CHECK" ARE EASY. Temperature setting pointer and bulb temperature pointer pivot on the same axis, indicating against the same scale face. This permits "glance" comparison of actual and set-point readings at considerable distance from the dial. An adjustable differential, variable between 0.8% and 4% of scale range, permits adjusting the operating bandwidth to balance closeness of control against slower cycling and longer equipment life.



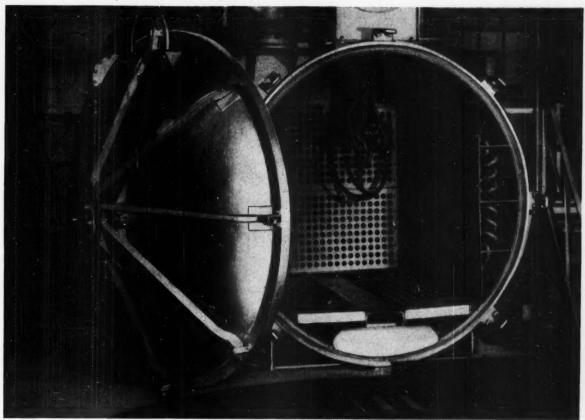
3. ACCURACY IS ASSURED. Temperature indication is accurate to within 3% over the 100° to 700°F range, including the effects of ambient temperature in the range of 50° to 150°F. Accuracy increases for narrower ranges. Uniform control and accurate calibration are maintained with typical Fenwal precision in this new, popular-priced addition to a famous line of temperature control and detection devices.



4. SEND FOR NEW BULLETIN. Get all the facts on how closely the new Series 540 meets your requirements for an economical, accurate indicator-controller. Write for comprehensive bulletin MC122. And remember, we're always ready to help in any problems concerning temperature control and detection. Fenwel incorporated, 1612 Pleasant Street,

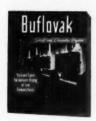


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Buflovak Chamber Dryers-engineered to the applicationimprove product · step up production · cut down costs



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Month after month, Chapman List 960 Valves deliver the goods on more different jobs than any other small forged steel gate valves. And maintenance charges are few and far between even under the toughest conditions.

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For every small forged steel gate valve application, specify Chapman List 960. Sizes from ¼" to 2", either rising stem with yoke (shown) or rising stem with inside screw. Bonnet joint is ground metal-to-metal or gasketed, depending on application. Pressure range is from 380 psi at 1000°F to

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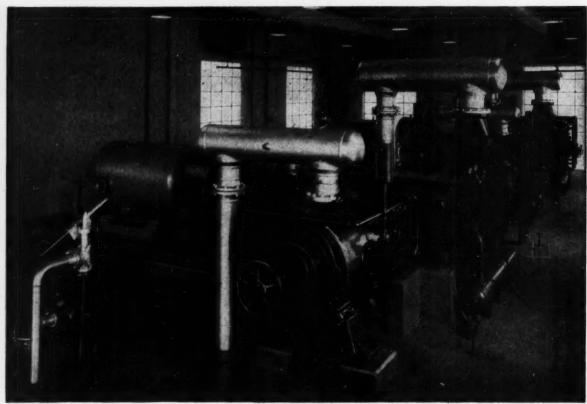
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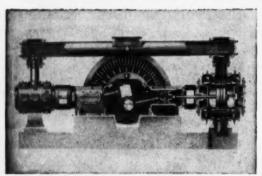
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LINEUP OF WORTHINGTON 2-cylinder gas compressors at Frontier Oil's new Tonawanda (N.Y.) refinery. Units are rated at 600 hp each,

Frontier's new refinery gets Worthington compressors



CUTAWAY VIEW of Worthington balanced-opposed compressor. Note low silhouette, modest foundation requirements, and double-throw crankshaft which permits as many as four pairs of cylinders to be arranged on single compressor frame.

"SEE the Worthington Cor-poration Exhibit in New York City. A lively, informative display of product develop-ments for industry, business and the home. Park Avenue and 41st Street."

At Frontier Oil Refining Company's big new refinery in Tonawanda, N.Y., two Worthington type BDC-2 balanced-opposed gas compressors have gone to work in the two stage compression of hydro-carbon gas mixtures. By selecting Worthington units, Frontier

Smooth, vibrationless operation. Two throw crankshaft with cranks set at 180 degrees gives opposed piston action.

Low-cost installation. Packaged design provides quick and easy field assembly. Lack of vibration permits location on small

In chemical plants and general industrial installations, these Worthington units are paying off in dependable operation. You can use practically any type of drive to power them. Like all Worthington compressors, they are equipped with the exclusive Feather* Valve — lightest, tightest, most efficient valve made.

Remember, no matter what your capacity or pressure requirements may be, there's a compact Worthington steam- or motordriven compressor to fill the bill. Write Worthington Corporation, Compressor Division, Section K.3.5, Buffalo, N.Y.



Only Worthington Compressors give you Feather Valve Performance

Balanced-Opposed Balanced Angle

Direct Connected Gas Engine

Y-Types



Typical Conveyoflo installation showing Model CFAB-T Conveyoflo Meter controlling flow of tobacco in automatic blending process. Conveyoflo employs pneumatic controller to automatically control feeder output within very narrow tolerances.

Conveyoflo Meters are serving in many other process industries: food, soap, fertilizer, pharmaceutical, steel, paper, glass, heavy chemicals, mining, power. What's your processing problem?

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- COMPACT... weight sensing mechanism completely contained within conveyor structure. No overhead levers. Panel stand only 9" x 18" may be any height.
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- RESPONDS ACCURATELY to rapid load variations.
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Weigh it with BUILDERS CONVEYOFLO . . . the modern meter for continuous, accurate weighing of bulk material passing over conveyor belts. This precision meter can be equipped with a Controller to maintain any desired preset rate of delivery from the conveyor in which it is installed. Or it can be used to pace auxiliary feeders in automatic processing systems. Conveyoflo is furnished as a separate, self-contained unit— or for installation in your present conveyor lines.

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KOVEN FOR INDIVIDUALIZED EQUIPMENT SINCE 1881

Next Steps in Atomic Progress... A Challenge to American Industry

The purpose of this editorial is to throw light on the significance for American industry of recent changes in the statutes that control the development of atomic energy.

The need for clear light on the meaning of this new legislation is made more urgent by the political confusion and distortion that marked its course through Congress. The politically inspired charges of "giveaway" that delayed its passage—charges that were almost totally unrelated to the legislation itself—helped to obscure the vital importance of the step finally taken by Congress.

In sober, post-Congressional fact, the principal significance of the new atomic legislation is that it extends to private enterprise responsibility for the development of peaceful uses of atomic energy, whereas heretofore this responsibility has rested in a tight government monopoly. And this extension is made on terms that emphasize the responsibility far more than they open any opportunity for economic gain in fulfilling it. The revised Atomic Energy Act provides that:

- 1. Industry may now own and operate its own nuclear reactors, under license from the Atomic Energy Commission. And it may build and sell nuclear reactors for export.
- Industry may use but not own nuclear materials at the discretion of the Atomic Energy Commission.
- 3. The Atômic Energy Commission will make available to industry scientific knowledge

that may be useful in developing peaceful applications of nuclear energy.

4. For the first time, industry will have the right to patent inventions in the field of non-military nuclear energy. However, "basic" discoveries must be made available to all companies in the field for a period of five years, after which they, too, will revert to normal patent status.

Two Kinds of Know-How

These provisions, despite the imposed limitations, represent the first positive step toward development of nuclear energy for peaceful applications in the United States. Potentially useful knowledge, previously locked in the minds of government scientists, will now be available to all those who are willing and able to put it to work for the good of mankind.

The advantages to be gained from enlisting the talents of American industry in the development of peaceful atomic applications are imposing. As The (London) Economist, Europe's leading economic journal, recently remarked, "The atomic scientists are in a position to surmise how atomic energy can be applied... but they lack the specialized knowledge of engineering design and operating technique just as industry itself lacks atomic knowledge." Now the engineers of private industry need no longer lack the atomic knowledge, and there is granted to them at least a restricted freedom to apply it to the solution of their engineering and operating problems.

But the new opportunity for private industry to find constructive uses for the science of nucleonics carries with it a grave responsibility. These uses must be so developed that they will benefit the people of all the free nations. It is essential that the United States, which pioneered in developing lethal uses for atomic fission, demonstrate to the world our paramount interest in its peaceful application. It would be a moral set-back to the free world almost beyond calculation if the Communists should be able to offer to the poorer nations of the world the benefit of low cost atomic power-provided by Communist technicians - while we concentrate primarily on building our stockpile of atomic and hydrogen bombs.

Race For a Peaceful Victory

Most of the experts are agreed that it may be many years—perhaps ten, fifteen or more—before the cost of electricity from atomic fission can be reduced to a level that will make it competitive with conventionally produced power in most regions of the United States. But most of the world is not nearly so fortunate as we are in power resources. Electricity, even at a cost far higher than the average that prevails in the United States, would be a blessing in many countries, and the nation that provides the technology to bring it into being will score a great moral victory.

The useful potential of nuclear energy is not restricted to the generation of electric power—although twenty years from now this use will be highly important to the power industry of the United States. Even with the limited research that has been done in this field thus far, the use of radioisotopes—the radioactive products of atomic reactors—is saving American industry an estimated \$100 million a year. Commissioner Campbell of the AEC, who made this estimate, believes that these savings may well reach \$1 billion a year within ten years. Radioisotopes are already at work in industries ranging all the way from paper manufacturing,

where they measure paper thickness, to pipeline transportation, where they mark the dividing lines between shipments of different products (at an estimated saving of \$500,000 a year). Medical applications of these same radioisotopes hold promise of longer and more comfortable lives for those who are stricken by cancer and other diseases.

Above All a Challenge

The new Atomic Energy Act is a crucial stride toward the day when all these benefits—and undoubtedly others not yet revealed by research—will be realized. But it is a step that is essentially permissive. It still leaves it to private industry for the most part to decide what is to be done and how soon.

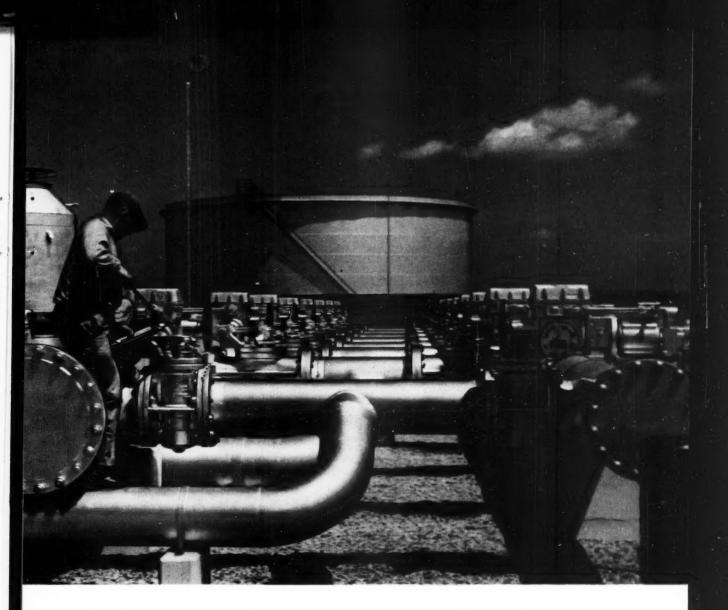
The new act is thus, above all, a challenge. It confers on private industry the responsibility to assume a leading role in the development of peaceful uses for nuclear energy, a step long urged by NUCLEONICS, a McGraw-Hill magazine devoted to atomic energy. To achieve a success in this task that will measure up to the requirement of the national interest, this development must command all the resources and ingenuity that private enterprise can apply - and do so without promise of glittering prizes surely to be won. But now that the responsibility has been defined and the challenge offered, American industry will, we believe, measure up to its grave and mighty import.

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Donald CMcGraw PRESIDENT

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PICTURE OF MAINTENANCE COSTS BEING LOWERED

Every plant that keeps complete records comes to the same conclusion—periodic valve lubrication *saves* money; it's valve failure and replacement that sends maintenance costs skyward.

That is the basic fact behind the Rockwell-Nordstrom valve design, for the internal lubrication system eliminates most reasons for valve failure—Rockwell-Nordstrom lubricant *prevents* galling, jamming, abrasive wear, and seepage.

Systematic lubrication of Rockwell-Nordstrom valves with the right Rockwell-Nordstrom lubricants

THREE WAYS THE NORDSTROM LUBRICANT WORKS

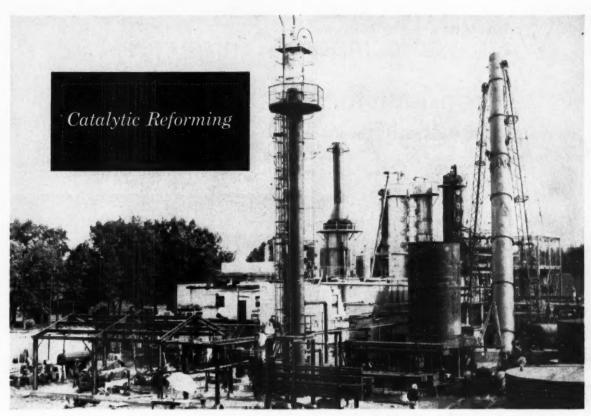
- Lubricant surrounds each valve port with a vapor tight pressurized seal. Nordstrom valves stay tight.
- 2 Lubricant acts as hydraulic jack—a fast quarter-turn to open or close. Nordstrom valves operate quickly.
- 3 Lubricant coats the plug for sliding action—no wear-producing wedging. Nordstrom valves operate easily.

inevitably leads to lower operating costs. There is no substitute for Rockwell experience—use it to save money on valves. Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

Rockwell Built

Lubricant Sealed for Positive Shut Off





Naph-Sol Refining Company, Muskegon, Michigan... UOP Platformer, during final phase of construction

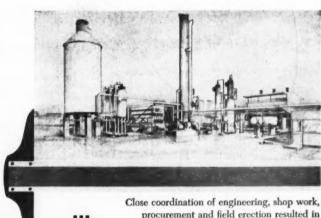
From contract to capacity in 6½ months

Fast but good ... that's what sweco promised when Naph-Sol decided to enter the high octane race with a sweco-constructed Catalytic Reforming Plant. In record time, the plant is ready to produce 1,000 barrels per day of high octane gasoline.

sweco service is fast because engineering...equipment fabrication and delivery... are rigidly coordinated with erection work at the plant site. Experience in our own extensive fabricating shops helps iron out timing problems, whether equipment is made by us or procured from outside suppliers. Close coordination of shop and field work results in substantial economies in both time and money.

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sweco is licensed to build the leading types of Catalytic Reforming and other petroleum processes. If you are planning a new plant or modernization of your present facilities, it will pay you to consult sweco.



Close coordination of engineering, shop work, procurement and field erection resulted in record construction of recently completed Naph-Sol plant depicted above.

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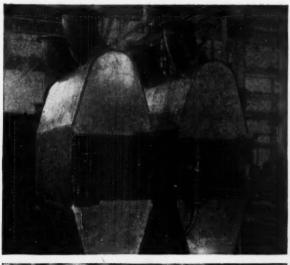
Through its patented construction Reineveld Centrifuges give you a deeper bowl in any frame size than any other centrifuge. This deeper bowl results in more filtering surface in the Reineveld than in any other centrifuge with the same bowl diameter.

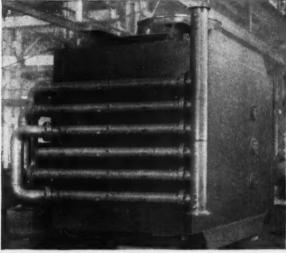
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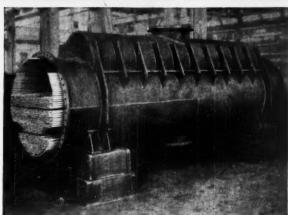
Booklet 5-RC-3 can help you judge the Reineveld Centrifuge for yourself.

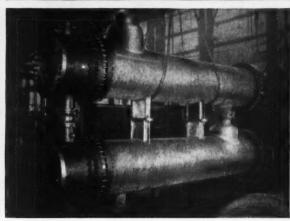
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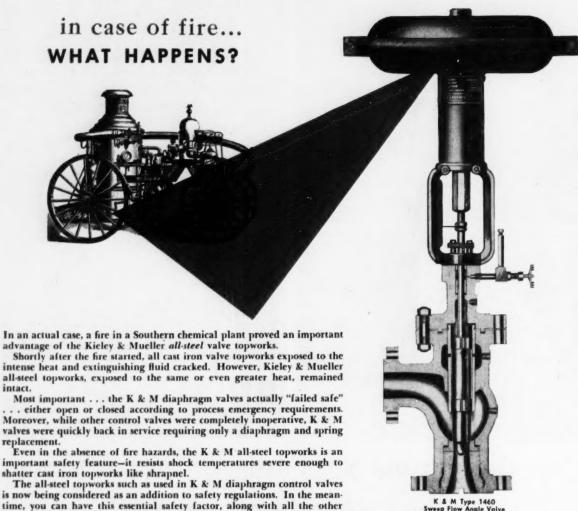


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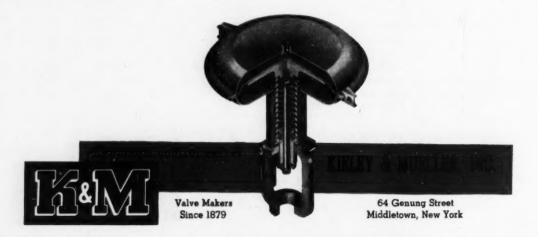
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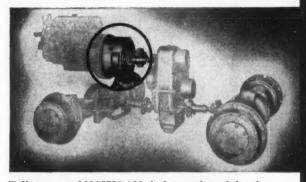




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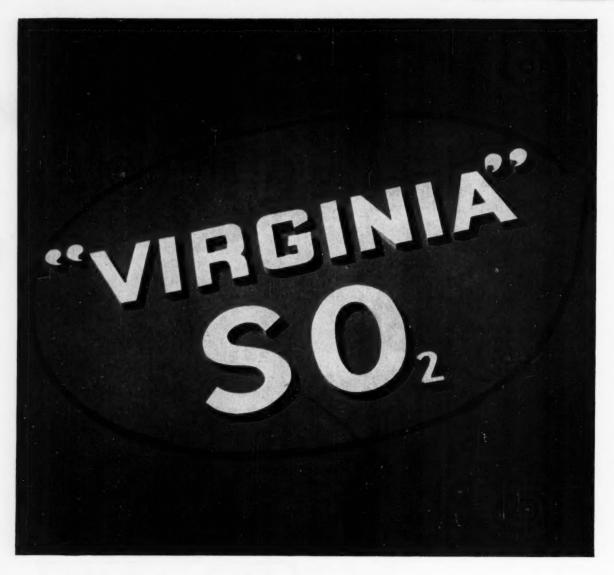
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This comprehensive service is largely responsible for "Virginia's" position as the top SO₂ producer in the nation. Our unexcelled production and shipping facilities—assuring you of prompt and dependable deliveries—

have also been contributing factors.

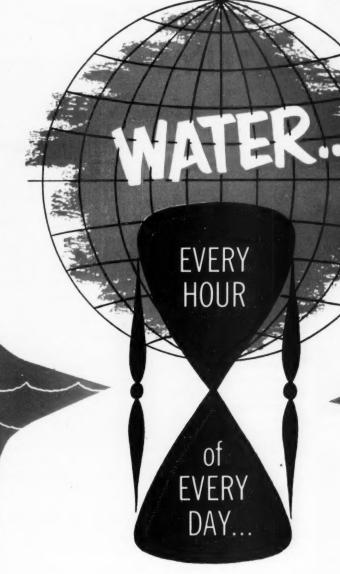
It is quite likely that you could put this versatile chemical to profitable use in your products or processes—cutting costs, saving time, improving quality. Let's investigate these possibilities together. Send today for our descriptive SO₂ folder—or call in a "Virginia" technical man for helpful consultation. There's no obligation. Industrial Department, VIRGINIA SMELTING COMPANY, Box 21, West Norfolk, Virginia.



Field Offices: NEW YORK • BOSTON • DETROIT • CHICAGO • ATLANTA • ASHEVILLE

Available in Canada and many other countries





Every hour of every day of every month of every year more gallons of water are pumped by Layne pumps than there are people in the whole wide world. That world endorsement of Layne quality and Layne "know how" in developing ground water resources and in engineering water installations is the strongest possible reason for consulting Layne—first—on any question relating to water.

Layne Associate Companies Throughout The World

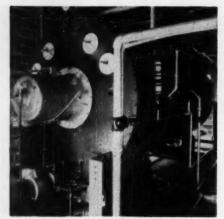
LAYNE & BOWLER, INC.

Memphis 8, Tennessee

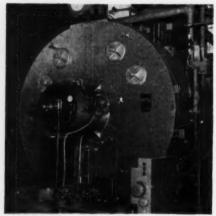


Water Wells . Vertical Turbine Pumps . Water Treatment

Steam for heating new fertilizer plant is supplied by this 40 hp. Powermaster.



This 400 hp. Powermaster generates 100 psi. steam for processing industrial fish oil.



Process steam at 175 psi. for rubber products plant, is supplied by this 500 hp. Powermaster

CHECKED YOUR STEAM COSTS LATELY?

Powermaster saves in many ways!

In chemical plants, *Powermaster* Packaged Automatic Boilers are supplying steam for processing and heating with outstanding reliability and economy.

Powermaster savings start with simplified installation. No special foundation or costly stack is required. As delivered, space-saving Powermasters are completely factory-assembled, fully equipped and wired ready for operation as soon as water, fuel, electrical and flue gas connections are made.

Once installed, a *Powermaster* keeps on saving with these advantages: high fuel economy at all loads, fully automatic operating and safety controls, maintenance-saving accessibility, hospital-clean boiler room, smokeless combustion and long, trouble-free performance. *Powermasters* are entirely designed and built by Orr & Sembower, Inc., and are rigidly fire-tested before shipment.

To meet your specific operating requirements to your best advantage, Powermaster offers you two models covering a capacity range of 15 to 500 hp. as shown in the chart below. Oil, gas, or combination oil and gas firing is optional with both models in all sizes.



Pressure range: 15 to 250 psi., steam or hot water.

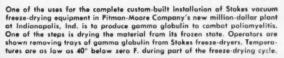
Check your steam costs, and then check the many cost-saving *Powermaster* advantages described and illustrated in our latest bulletins. Send for your copies NOW!



PACKAGED AUTOMATIC BOILERS

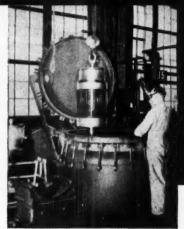
Sizes to 500 HP; pressures to 250 psi.

Operator transfers evacuated retort from heating to cooling station of Stokes Vacuum Annealing Furnace, designed and built for the processing, annealing and other heat treatment of titanium, zirconium, hafnium, copper and other metals.









Installation of Stokes Rotary Vocuum Dryers used by Metals Disintegrating Co., Berkeley, California, for drying of aluminum powder. Highly oxidizable materials can be handled without any danger of combustion or explosion when they are processed under vacuum.

Diesel locomotive armature being removed, after impregnation, from Stokes high vacuum impregnating tank in the San Bernardino, Calif., plant of Atchison, Topeka & Santa Fe Railway. Electric motars for the Santa Fe's ("Chief" and "Super Chief" develop such excessive heat that ordinary insulation would swell or burst, causing the rotors to "freeze" in the mounting. By impregnating these rotors with protective resins under high vacuum in Stokes impregnators, each turn of wire is held in place, motors operate without interruption.

Vacuum at Work

Diesel locomotive motors, paper and metals, medicines, electrical parts, toys... are but a few in a wide range of products which are processed in vacuum for the good of mankind and the profit of business.

The application of vacuum engineering to industry is a major function with Stokes engineers. And naturally so, for it is at Stokes' that many of today's accepted procedures of vacuum processing had their inception during the last fifty years.

Stokes is First in Vacuum . . . first in the design and manufacture of practical vacuum processing equipment . . . and Stokes engineers are available for consultation on opportunities to apply vacuum processing to your business.

F. J. STOKES MACHINE COMPANY, PHILADELPHIA 20, PA.



STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment



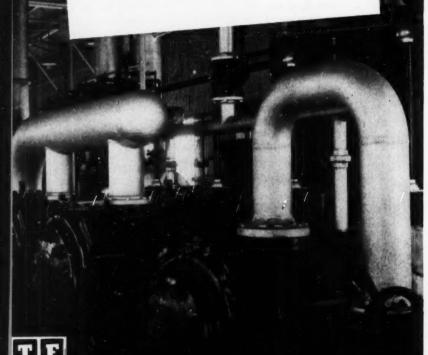
Naturally the organization that developed the first complete line of welding fittings has remained first...in design...in breadth of types, weights, sizes and materials.

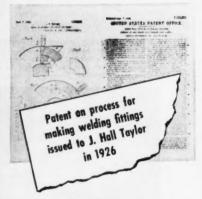
That is why those who have followed the development of the WeldELL line, usually refuse to consider any other type of welding fittings.

See your Taylor Forge Distributor for up-to-the-minute facts.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS - General Offices and Visiting P.O. Box 485, Chicago 90, Illinois - Offices in all principal cities P.O. Box 485, Chicago 90, Illinois - Offices in all principal cities Plants at: Carnegle, Pa.; Fantans, Calif.; Gary, Ind.; Hamilton, Ontario, Canada Plants at: Carnegle, Pa.; Fantans, Calif.; Gary, Ind.; Hamilton, Ontario, Canada





The formula was written in 1926—

The invention of oxyacetylene and electric arc welding touched off the greatest single advance in modern piping practice—pipe welding.

The old way—the screwed fittings and heavy flanged fittings—put up a brave fight, but the handwriting was on the wall! For all important piping the old method was through.

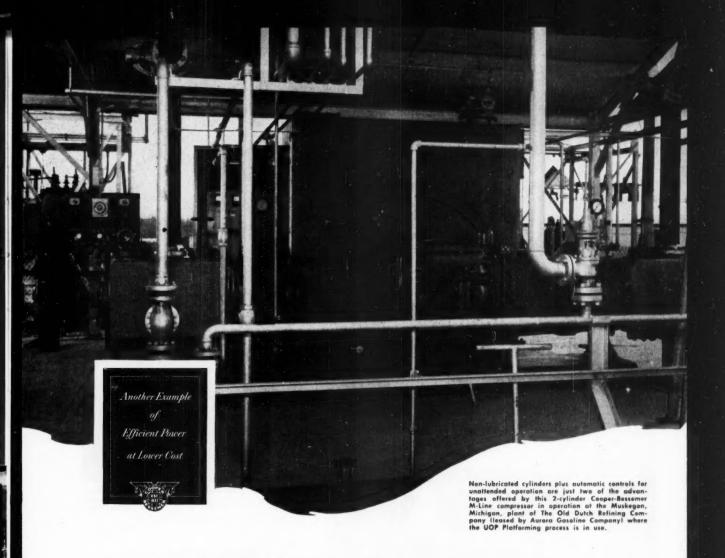
Proof that Taylor Forge had foreseen this clear back in 1926 is shown above. Significantly enough, the process covered by this patent is still employed to give WeldELLS certain advantages not found in any other welding fittings.

But Taylor Forge experience had suggested careful procedure — had foreseen that pipe welding could not advance beyond its crude, torch-happy stage until *all* necessary fittings were provided to make *complete* welded systems.

It took a number of years to do this job with Taylor Forge thoroughness, but in 1931 the announcement was made of the first complete line of seamless butt welding fittings — the first line to include not only elbows and return bends, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps, and the all-important (and then revolutionary) welding neck flanges.

Out of 31 years of designed piping experience had come the greatest contribution to piping permanence.

An episode in the story of Taylor Forge leadership in designed piping



"HYDROGEN COMPRESSES CLEAN" ... with Cooper-Bessemer's non-lubricated cylinders

RECYCLING millions of cubic feet of hydrogen a day for the UOP Platforming of low-octane gasoline, demands continuing efficiency from a smooth working compressor that will not contaminate the recycle hydrogen. That is one of the reasons why The Old Dutch Refining Company, leased by Aurora Gasoline Company, recently installed a 2-cyclinder Cooper-Bessemer FM compressor in their modern plant in Muskegon, Michigan.

To avoid contaminating hydrogen with oil in the recycle gas, Cooper-Bessemer successfully developed a non-lubricated compressor cylinder.

Operating against micro-smooth hardened cylinder liners, these 8" diameter carbon pistons require no lubrication whatever. With a mirror finish, the cylinder bores reveal no excessive wear.

No matter how exacting or complex your compressor problems, check the advantages offered by Cooper-Bessemer M-Line compressors. For dependability and money-saving operation, you can rely on Cooper-Bessemer — one of America's oldest engine builders offering the latest in engineering advancements.

COOPER-BESSEMER

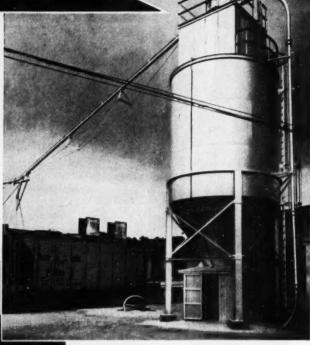
New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Ma. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.



FIK5T

Avondale Mills

inaugurates use of air-conveying in the textile industry



Starch storage tank. Flexible metal hose connecting hopper-bottom car to permanent conveying line underground, and leading upwardly (right) to Airveyor receiver atop of tank. Conveying line (left) for delivery of material from storage to process in plant

IRVEYOR, unloads and conveys



Airveyor unloading receiver and storage bin (right). Conveying line from storage to Airveyor filter (left) above slasher room in plant,

NOTHING MOVES BUT THE MATERIAL

It is reported that Avondale Mills is the first company in the textile industry to adopt air-conveying of starch from bulk cars to storage, storage to process, in its plant at Pell City, Alabama. Avondale also uses the Airveyor for handling starch at its Alexander City plant.

Previous to the installation of the Airveyor, starch was received in bags in box cars, necessitating manual handling with its attendant high cost. Now, starch (grit or pellet), is unloaded in bulk from hopper-bottom cars under partial vacuum, conveyed through dust-tight pipe lines to a 160,000-lb. storage tank at rate of approximately 12 tons an hour, without dust or loss of material. The system is so arranged that starch can be conveyed direct from car to the slasher room, by-passing storage, if so desired.

Avondale not only saves by eliminating costly labor charges, but the price of starch, purchased in bulk is less than that purchased in bags.

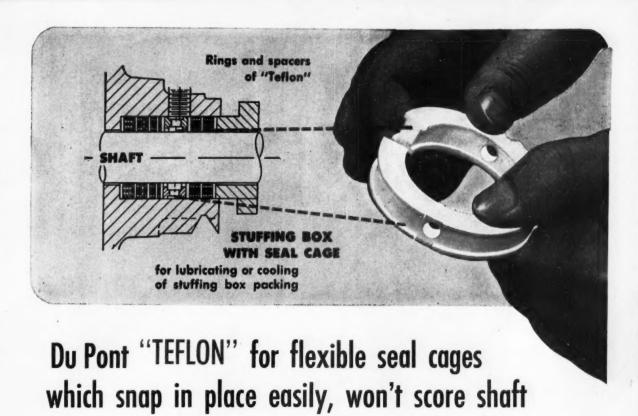
The Airveyor is clean, safe, efficient. When you have an unloading, or in-plant conveying problem, why not take advantage of Fuller's 27 years of experience in the field of air-conveying. A study of your problem will cost you nothing . . . may well be your first step forward toward consistently profitable operation and smoother flowing production. Write us today!

FULLER COMPANY-CATASAUQUA, PA.

Branch offices

Chicago—San Francisco—Los Angeles—Seattle—Birmingham

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS . . . COMPRESSORS AND VACUUM PUMPS . . . FEEDERS AND ASSOCIATED EQUIPMENT



"Teflon" is strong and chemically inert . . . offers users of process equipment many unique advantages

These flexible seal cages of Du Pont "Teflon"* tetrafluoroethylene resin supply annular space in packing for lubrication with oil or grease, or for cooling. Users of pumps and other process equipment will appreciate how quickly and easily these flexible seal cages of "Teflon" snap on and off a shaft. They're tough—won't bend or collapse under extreme gland pressure. Yet there's no danger of a scored shaft or sleeve from these seal cages of "Teflon," manufactured by Chemical and Power Products, Inc., New York City.

Today "Teflon" is used extensively in process industries. Its chemical inertness, high heat resistance, low temperature toughness and low coefficient of friction make this engineering material particularly adaptable to severe service conditions.

Have you and your company investigated the properties of "Teflon" and the other members of the Du Pont family of engineering materials—"Alathon"* polyethylene resin, "Lucite"* acrylic resin and "Zytel"** nylon resin? By evaluating their properties in terms of your own design and service problems, many product improvements may prove possible.

Use the coupon below for complete information on the Du Pont engineering materials.

*Registered trademark of E. I. du Pont de Nemours & Co. (Inc.)
**Trademark of E. I. du Pont de Nemours & Co. (Inc.)



E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department Room 258, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont "Teflon" tetrafluoroethylene resin: Uses : Processing Techniques : Properties : I am also interested in receiving more information on: "Zytel" nylon resin : Alathon" polyethylene resin : Lucite" acrylic resin :

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Firm Name	
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City	
State	
Type of Business	



NEW STANOLITH GREASE

A new grease! White and clean in appearance, STANOLITH Grease White is the perfect grease for use in food and beverage plants. Specially recommended for bakeries, breweries, candy factories, canning and cereal plants, chemical processing plants, dairies, distilleries, meat processors—all industries where clean, sanitary operating conditions are at a premium.

• STANOLITH Grease White is a new high quality, multi-purpose lithium soap grease with a clean, white color. It assures you of unmatched lubricating cleanliness plus unmatched lubricating efficiency.

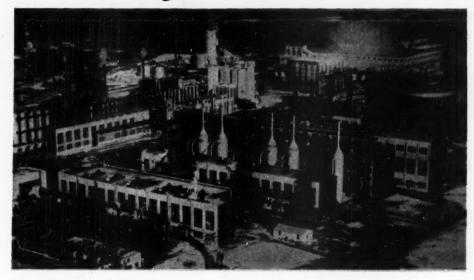
In addition to the high-temperature and water resistant properties, characteristic of most lithium greases, Standlith Grease White has superior mechanical and chemical stability. It provides a water-resistant lubricating film that gives this remarkable grease extended multi-purpose usage in a wide variety of applications. Easily handled in all usual types of grease-dispensing equipment, it is safe, easy-to-use, clean. Call your nearby Standard Oil lubrication specialist for full details on new Standlith Grease White.

STANDARD OIL COMPANY (Indiana)



IF YOU WANT PURITY, YOU NATURALLY WANT

Anhydrous Ammonia



OUR HOPEWELL, VIRGINIA NITROGEN PLANT. WORLD'S LARGEST producer of Nitrogen and Ammonia Products, Nitrogen Division, has spent over \$50,000,000 since the war, improving service and building ultra-modern processing facilities.

The pioneer producer of high purity Anhydrous Ammonia, Nitrogen has an almost unlimited fund of skill and know-how that comes from 60 years' experience. This experience is at your command, ready to help you with Technical Service in the use and handling of Ammonia—with Technical Service Manuals—or with fast, dependable scheduled deliveries wherever your plant may be located.

If purity is important to you—and it is in most industries—why specify anything but the best...especially when the best costs no more?

(An interesting highlight: Our Hopewell, Va. plant was America's chief source of high purity Nitrogen during the war, while Government plants were being built.)

First In Ammonia Since 1890

NITROGEN DIVISION

ALLIED CHEMICAL & DYE CORPORATION
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Ironton, Ohio • Orange, Texas • Omaha, Nebraska

Ammonia * Sodium Nitrate * Urea * Ethylene Oxide Ethylene Glycol * Diethylene Glycol * Triethylene Glycol Methanol * Formaldehyde * Nitrogen Tetroxide U.F. Concentrate ~85 * Nitrogen Solutions Fertilizers & Feed Supplements



Anhydrous Ammonia Refrigeration grade Commercial grade

Ammonia Liquor
Cylinder Ammonia
Refrigeration grade

SHIPPING:

In tank cars from our producing plants at Hopewell, Va., South Point, Ohio and Omaha, Neb. In cylinders, fast delivery from 49 coast-to-coast distribution points!

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- Please have your specially trained Ammonia Technical Serviceman call to discuss the economical use, etc. of Anhydrous Ammonia. No obligation.
- Please send your valuable handbook "Guide to use of Barrett® Brand Cylinder Ammonia." (Shows most economical usage; contains chemical properties, handling, charts, etc.
- Please n/nd your free Ammonia Leak Detector Kit. (Pocket size, this handy kit can be used over and over again.)

NAME & TITLE

COMPANY

ADDRESS....

No other drive does all these jobs like

Link-Belt SILENT CHAIN

YES, if you need a drive like any one of these six, you're money ahead with SILENT CHAIN

Combining the flexibility and quietness of a belt with the positive action and durability of a gear—Link-Belt Silent Chain offers unmatched advantages for a wide range of drives. Check these reasons why:

- Lower cost—often lower in first cost, always lower in ultimate cost.
- Longer life trouble-free performance for 25 or 30 years is common.
- No dismantling machine or removing sheaves for repairs.
- Better than 98% efficiency.
- Maintained ratio assures full productive capacity.
- Slipless action assures a better product.
- · Easy to install.
- Safe to employees operates in oil-retaining casing.



New 88-page Book 2425 gives complete data on silent chain. Ask a Link-Belt engineer or distributor for your copy today.



SILVERSTREAK SILENT CHAIN DRIVES

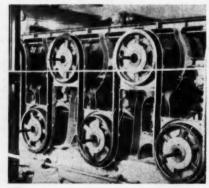
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York? Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



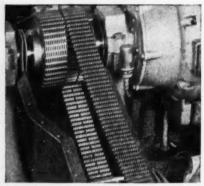
Production increased 33% when speed of this peeler lathe was stepped up by installing two silent chain drives. Neither engine nor lathe had to be moved.



long life under severe service—This 250hp Link-Belt Silent Chain Drive has operated line shaft in cold draw section of seamless tube company since 1916.



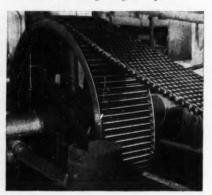
Accurate timing is guaranteed for this dryer by Link-Belt Duplex Silent Chain. All shafts travel at uniform angular velocity, permitting precise coordination of process



Constant, high speeds were assured by equipping each of 48 automotive test stands with two Link-Belt Silverstreak Silent Chain Drives.



fractional hp drives are positive and dependable with Link-Belt Silent Chain. Above, two 3/16" pitch chains drive machine fabricating refrigerator parts.



Minimum maintenance—This is one of 24 Link-Belt Silent Chain beater drives in a pulp mill. All have operated for many years with little attention.

ship kid-glove chemicals in Hackney Drums



Here's the returnable shipping container to protect your sensitive chemicals, oils, and food products against contamination during shipment or in storage. Tight head or removable head Hackney Drums are available in several types of stainless steel—or in Monel metal—or in nickel. Choose the metal that treats your product best—and be sure the high purity of your product is protected all the way to its destination.

Both open head and tight head models are ruggedly built for long life and low damage claims. Both have smooth, crack-free interiors that are easily kept spotlessly clean. Can be furnished as mixing containers without I-bars, cover or clamp ring if desired.

Write for specifications and details.
Ask for the new Hackney Drum and
Barrel Catalog which describes Hackney engineered containers for all solids
and liquids.

PRESSED STEEL TANK COMPANY

Manufacturer of Hackney Product

1447 S. 66th St., Milwaukee 14 ● 52 Vanderbilt Ave., Room 2025, New York 17
203 Hanna Bldg., Cleveland 15 ● 936 W. Peachtree St., N. W., Room 113, Atlanta 3
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18 W. 43rd St., Room 15, Kansas City 11, Mo. ● 140 Wallace Ave., Downingtown, Pa.





CONTAINERS FOR GASES, LIQUIDS AND SOLIDS

THE NEW

AMERIONE

AAF INTRODUCES NEW "TWIST" IN DRY CENTRIFUGAL DESIGN

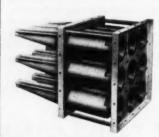
AMER Tube



Here's the new "twist" in dry centrifugal design! Only 4" in diameter, the Type G AMERclone tube has an approach velocity of 1000 fpm and a capacity of 333 cfm. Note how clean air travels out through end of tube without changing direction while 10% of air plus collected dust is bled off and thrown into primary dust hopper.

AMER Lone Cell

Nine AMERclone tubes are combined to form a single AMERclone cell having a face area of only 20" x 20" and a nominal rating of 3000 cfm. Any number of cells can be used to achieve the desired capacity and they may be assembled to form a unit of a height and width which conform to your space limitations.





AMERcione—another product of AAF research—is designed to handle large exhaust volumes containing dry, granular dust in high concentrations. It introduces many features new to dry centrifugal design which result in the following advantages—

High Collection Efficiency

AMERclone's efficiency is comparable to or better than that of other high efficiency dry-type centrifugal.

Requires Less Space

High approach velocity and single-direction air flow of the AMERclone tube reduces space requirements to as little as one-half that of collector using the conventional reverse air flow principle.

Less Subject to Abrasion

Cast iron tube construction plus elimination of dust re-entrainment assures long life under heavy abrasive service.

Maintains Efficiency

Regardless of variation in primary air volume, AMERclone's maintained secondary air circuit compensates for variation in available centrifugal forces—assures constant collection efficiency over wide operating range.

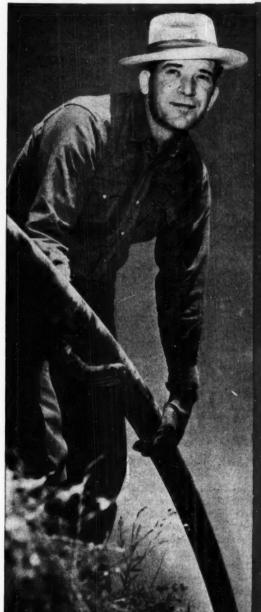
Write today for Bulletin No. 291 containing complete technical data on the new AMERcione.



American Air Filter

COMPANY, INC.

American Air Filter of Canada, Ltd., Montreal, P. Q. . 326 Central Avenue, Louisville 8, Kentucky



VARNISH, SHELLAC AND PAINT

MOTOR OIL AND GASOLINE (ADDITIVES)



CHEMICAL FOR TENITE BUTYRATE USED FOR NEW PLASTIC PIPE

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34 successful years of leadership in serving industry

Here's why more and more industries in the paint, chemical and surface coating fields rely on Enjay. They know Enjay supplies a complete line of uniform, high quality petroleum chemicals, and assists in developing new or improved products through

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For proved product results plus expert technical assistance, make it *your* business to specify Enjay.

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PETROHOL
Methyl Ethyl Ketone
Dewnxing Aid
Ethyl Ether
Isopropyl Ether
Reference Fuels

SURFACE COATING

PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Secondary Butyl Alcohol
Secondary Butyl Acetate
Isopropyl Acetate
Isopropyl Acetate
Dicyelopentadiene
Ethyl Ether
Isopropyl Ether
Isopropyl Ether
Isopropyl Ether
Jsopropyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Denatured Ethyl Alcohol

CHEMICAL

PETROHOL 91
PETROHOL 95
PETROHOL 95
JAYSOL
Jao-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Dridecyl Alcohol
Dicyclopentadiene
Butadiene
Ethyl Ether
Isopropyl Ether
Tetrapropylene
Aromatic Tars
Benzene
Acetone
Methyl Ethyl Ketone

AUTOMATIC PROTECTION FOR AIR, GAS AND STEAM SYSTEMS

WET DIRTY AIR IN DIRT AND LIQUID RESERVOIR LIQUID DRAINS. AWAY

Dry, clean air is delivered by compact Selas Liqui-Jector to chemical processing equipment.



VAPE-SORBER

for adsorp



DEHYDRATOR

Dual-tower unit for procssing ultradry air, gases by means of

CLEAN DRY AIR OUT

> UPPER CERAMIC TUBE PASSES AIR ONLY

LOWER CERAMIC TUBE PASSES LIQUID ONLY



Continuously Removes

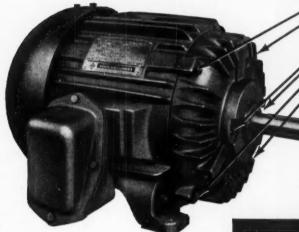
• The Selas Liqui-Jector is a simple unit that strips incoming air, gas or steam of condensate and dirt particles as fine as 30 microns. It functions constantly and automatically to eject the moisture whether it be in the form of mist, droplets, or slugs . . . whether the incoming flow is high or low.

As you can see, operation is extremely simple. There are no moving parts to wear out or require servicing. The cast bronze housing is corrosion-proof. Maintenance consists of periodic inspection, easy cleaning of filters, and removal of accumulated dirt. Units are available for conditioning air, nitrogen, hydrogen, oxygen, propane, butane, generated atmospheres and other gases in capacities from 10 to 5,000 cfm. pressures from 25 to 3,500 psi.

Can the Liqui-Jector serve you? It can if your process includes liquid aeration and agitation, drying and spraying operations, air-operated mechanisms and instruments. Write for bulletin "How To Select Liquid-Gas Separators."

FLUID PROCESSING

It takes Six Bolts -

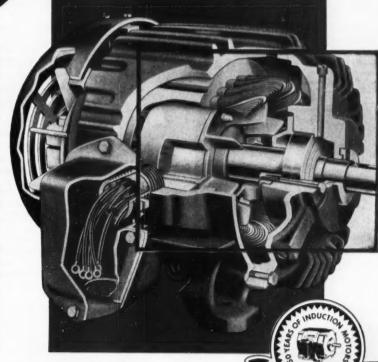


To give full bearing protection for greater motor performance

The two extra bolts in the end housing of every Allis-Chalmers ball bearing motor are the proof of extra protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.



Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS



"CONTINUOUS"

is a money-making word!...

Many leading chemical and food manufacturing plants consider filters and settling tanks about as obsolete as gas lights . . because "stop-and-go" separation is inefficient.

Today... their place has been taken by De Laval Centrifugals – for continuous, more profitable separation.

No longer is production slowed down to the pace of its slowest operation...no longer is its smooth rhythm broken. Continuous separation with a De Laval centrifuge, cuts costs, increases profits... has changed the whole processing picture.

If your production involves liquid-liquid, liquid-solid or liquid-solid-liquid separation...if it calls for clarification or concentration...get the facts on what De Laval Separators and Clarifiers can do for you...now!

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York • 427 Randolph
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DE LAVAL

for faster processing systems

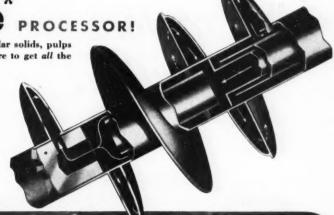
if you have a Cooling...Heating...or Drying problem

investigate the revolutionary advantages of ...

THE holo-flite PROCESSOR

If you have processes where slurries, granular solids, pulps or pastes are cooled, heated or dried, be sure to get all the facts on HOLO-FLITE advantages.

HOLO-FLITE handles such processes — in continuous flow — in as little as 1/5th the space of other types of heat exchangers. What's more, it is readily adaptable to a wide range of applications — is simple to install and maintain — and provides many other important savings.



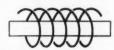
typical HOLO-FLITE advantages...



ITS APPLICATION FLEXIBILITY is almost unlimited. It cools, heats, or dries. It handles granular solids, pulps, pastes, slurries and fluids with equal ease. Its heat transfer agent can be water, refrigerant, hot oil, Dowtherm, steam or other liquids or vapors at any of a wide range of temperatures. It cools materials in ranges from 1800°F to 0°F. It heats and dries with hot oil to 600°F...with hot oil to 600°F...with steam to 150 lbs. per sq. in. pressure.



THE LARGE HEAT-TRANSFER SURFACE saves space — HOLO-FLITE requires as little as 1/5th the space of other heat-exchange equipment of comparable capacity. Moreover, a more complete heat transfer is effected, resulting in more uniform processing.



ROTATION IS SLOW — granular and powdered solids are handled with practically no dusting — negligible abrasion. There are no dust recovery problems — a further saving in installation, maintenance and operating costs!





ITS OPERATING CAPACITY is readily adaptable to virtually any requirements by simply varying the diameter, pitch, and length of flights, as well as the number of "tiers." Multi-tier units require no more floor space than single-tier installations!



HOW HOLO-FLITE WORKS...

Basically the HOLO-FLITE consists of one or more flights of hollow-bladed screw conveyors. The product to be processed moves through a trough housing the conveyor screws. The heat-transfer fluid circulates through the hollow blades and shafts of the conveyor. The product is constantly rotated into, around, under and over the blades and shafts through which the heat-transfer fluid is circulating, assuring quick, uniform heat passage between the two mediums — as the product is continuously moved along in a bulk-flow without interruptions!

GET THE COMPLETE FACTS on Holo-Flite savings and how this fieldproven unit can save space, time and money on your processing operations. This eight-page descriptive bulletin will gladly be sent on request. No obligation, of course!





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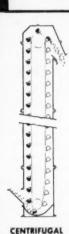
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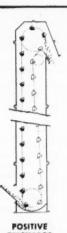
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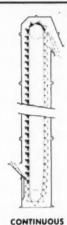
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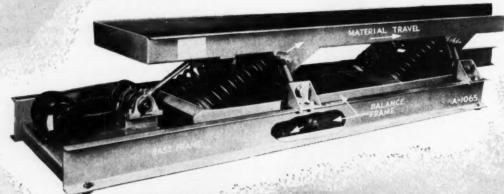


BUCKET ELEVATORS

13,54

Natural Frequency

VIBRATING CONVEYORS



CAN CUT HANDLING COSTS OF

Pulverized, Granular or Lump Materials . . . Castings, Boxes, Packages

Hot or Cold . . . Wet or Dry . . . Corrosive or Abrasive

Natural Frequency Conveyors will move materials horizontally or up inclines of 10° at speeds up to 70 F.P.M. They can also be used to heat, cool, dewater, dry or screen a wide range of materials.

LOW POWER COSTS

Natural Frequency Conveyors utilize the regeneration of power from springs designed to vibrate at the natural frequency best suited for conveying—the new power required is reduced to a minimum. They are built in various widths and in 10 foot sections—one drive will operate several sections.

NO EXPENSIVE FOUNDATION

Due to elimination of vibration from base

frame, these conveyors can be mounted or suspended, without special foundations or bracings. Conveyor units can also be used in temporary locations without anchoring.

NO SPILLAGE

There is no violent agitation to cause spillage. The trough is free of obstruction to flow, or pockets to trap perishable materials for spoilage or infestation. All conveyor surfaces can be easily cleaned and sterilized. Furnished with standard open troughs, but enclosed or special troughs for scalping or dedusting can be furnished.

Get complete information on the Natural Frequency Vibrating Conveyor. Ask to have an S-A engineer call, or write for Bulletin No. 353 which contains specifications and general information on dimensions, etc.



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Big Quality Package! Available up to 80 hp — heating or processing — steam or hot water. A complete unit from a single tource. CLEAVER-BROOKS modorn - B boiler

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• This NEW CB boiler has EVERYTHING needed to bring big boiler standards to commercial, industrial and institutional users with small capacity requirements. Despite its unusual, compact size you get big boiler performance — from matched-quality components, proved the world over on thousands of Cleaver-Brooks self-contained units.

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Call your nearest CB boiler representative (see your phone directory) or send for this illustrated catalog describing the NEW CB—designed by Cleaver-Brooks, originators of self-contained boilers.



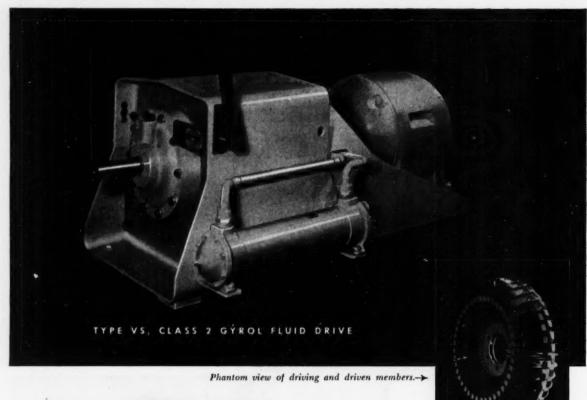
gives you all the quality features of time-tested self-contained design

- FOUR-PASS FIRETUBE CONSTRUCTION longer gas travel scrubs heat from flame means lower fuel costs guaranteed efficiency of 80% when firing with oil.
- SILENT OPERATION even at peak load this boiler more than meets the low sound levels required for schools, hospitals, institutions.
- FULL FIVE SQUARE FEET of heating surface per boiler hp for longer service life and low maintenance.
- FUEL FLEXIBILITY burns available light oil, gas, or combination oil/gas simple, quick fuel changeover on oil/gas models.
- FAST, EASY MAINTENANCE front and rear doors hinged for fast inspection, cleaning or servicing boiler.
- AUTOMATIC SAFE OPERATION all controls centralized and conveniently located modern electronic combustion control is standard equipment.
- COOLER BOILER ROOM fiber glass blanket insulation and 16 gauge metal sectional lagging are non-corrosive, moisture and heat resistant.
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Originators of the Self-Contained Boiler



New Girol Fluid Drive is reversible while in motion!

American Blower's new, class 2, adjustable-speed fluid drive offers unlimited application possibilities!

Newest member of the American Blower Gýrol Fluid Drive line, this versatile unit can be reversed while in motion—at any variable operating speed—by merely reversing the direction of rotation of the motor!

You'll find many other big advantages in this compact, self-contained unit for shockless, adjustable-speed control of fans, blowers, centrifugal pumps and compressors—and a wide variety of other industrial uses! Check the features of this new Gýrol Fluid Drive and see if it can be used in your own plant. It's a safe bet you will find several money-saving applications!

Get complete information about the American Blower Class 2, Adjustable-Speed Gýrol Fluid Drive from your nearest American Blower Branch Office. Or write us direct, Dept. 180-7, for your free copy of Bulletins 9419 and 9519. Do it, today!

FEATURES

- Can be reversed while in motion by reversing motor
- Speed range 5-1
- Across-the-line starting on many applications
- Motor can reach full speed before engaging load
- A compact, self-contained unit
- Trigger-action response—adjustable speed
- Speed may be controlled manually or automatically
- Six sizes, 7½ thru 800 hp speeds up to 1800 rpm

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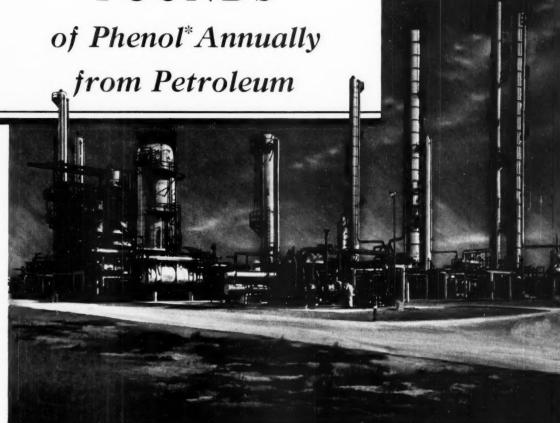


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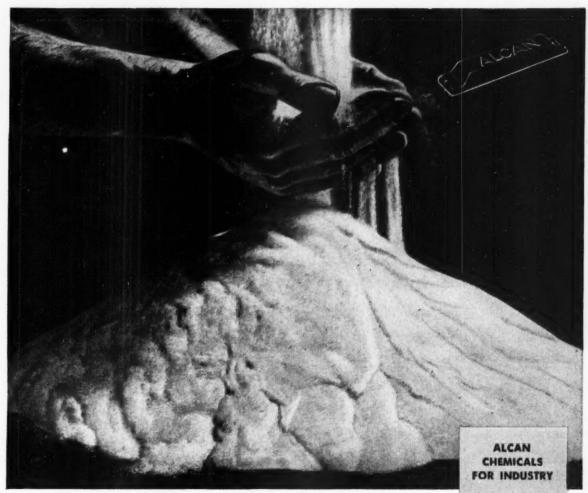
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- Laboratory research, and the exploring and surveying of material resources throughout the free world;
- Mining and processing of raw materials in many different countries;
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One of Alcan's sister companies, Aluminium Limited Sales, Inc., distributes Alcan Chemicals in the United States. The office near you will be glad to help you with your special chemical requirements.



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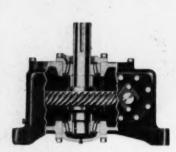
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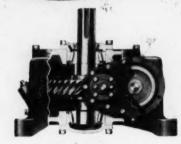
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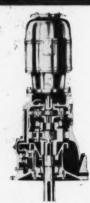
Reduction Unit



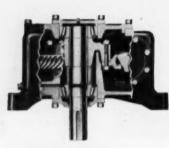
Worm Unit, type UT Shaft up



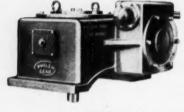
Helical-Worm Unit type HUT, Heavy duty



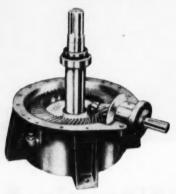
"MotoReduceR," Vertical type VS: VC & VD



Worm Unit, type VT Shaft down



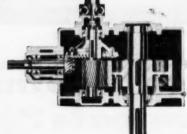
Double Worm Unit type DVT



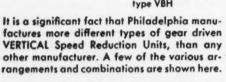
Spiral-Bevel Cooling Tower Unit type CT



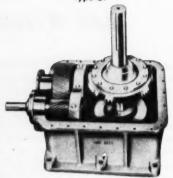
Worm Unit, type VTS "Steeple" type



Spiral-Bevel Helical Unit type VBH



Possibly one, or several of these types may be just what you have been looking for. Send for Literature and Details on any or all Philadelphia Speed Reducers . . . or write us about your vertical drive requirements and we'll recommend the most suitable Reducer.



Cooling Tower Unit Helical Spiral-Bevel, type CT

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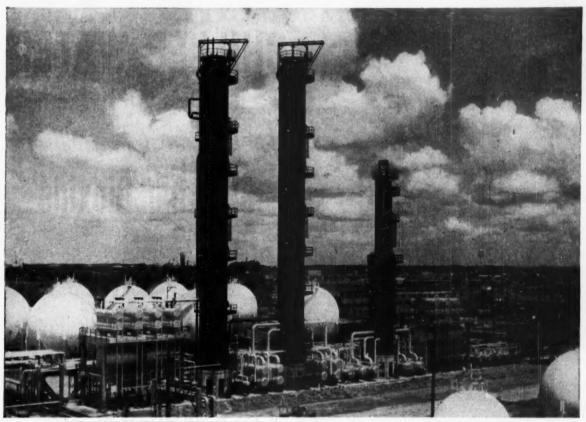
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WHAT'S NEW IN WELDED VESSELS



New Solvent Distillation Unit—The big towers shown here are the main components of the recently completed \$5 million plant addition to the U. S. Government-owned butadiene plant at Port Neches, Texas. Constructed by the Lummus Company, and operated by the Neches Butane Products Company for Federal Facilities Corp., this solvent distillation unit will produce butylenes, the raw material for butadiene. The towers were fabricated at Bethlehem's Beaumont Fabricating Works.



On Its Way—Here is one of the solvent towers for the distillation unit shown above, ready for shipment from Beaumont to Port Neches on the Gulf Coast. It stands 137 ft high and contains 50 accurately positioned bubble trays. Bethlehem also fabricated the 144-ft solvent stripper tower and the 90-ft solvent stripper tower.

For further information about welded vessels, towers and other equipment for chemical and petroleum processing, call the nearest Bethlehem sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



I-R Steam-Jet Refrigeration provides 100 gpm of

CHILLED WATER

for low-cost production of

Chlorine Dioxide

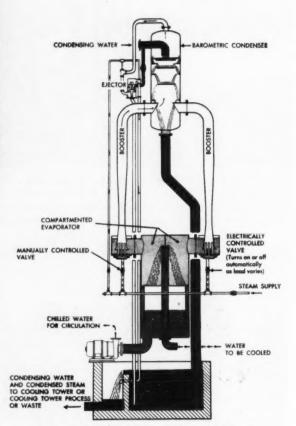


Diagram of I-R steam-jet cooler with barometric condenser and two boosters.

Here at the P. H. Glatfelter Company in Spring Grove, Pa., chlorine dioxide for bleaching wood pulp is produced at low cost by a Solvay generating plant. The process requires an abundant supply of chilled water for absorbing the unstable gas safely and in the desired quantity.

The Ingersoll-Rand steam-jet installation shown above provides 187½ tons of refrigeration, cooling 100 gpm from 90° to 45°F. The 2-stage unit with two boosters provides for maximum economy at part load operation. An I-R Class CRV pump handles the chilled water from the evaporator.

The safety, simplicity, dependability and economy of I-R steam-jet refrigeration make it the ideal equipment for use where steam is available and temperatures down to 35°F are required. For complete data on any application, call your Ingersoll-Rand representative or branch office.



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Big head start, Kodalith Film prints of elements which are repeated from time to time are kept on file. When a new design calls for any of these elements, the draftsman merely tapes the right films on clear acetate and orders an Autopositive. No redrafting!



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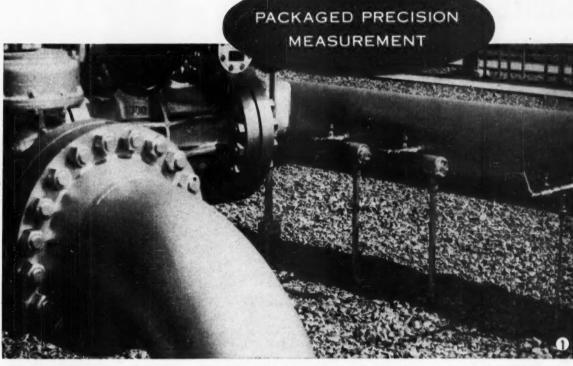
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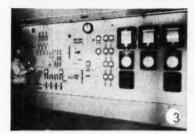
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Pressures from SR-4 cells installed on suction and discharge lines at all ten stations (Photo 1) are channeled through the Baldwin console which is the brains of the remote pressure indicating system (Photo 2) to a master control panel (Photo 3) which shows at a glance pressure readings at all points.

A leading pipe line company reports:

"Corrosion-proof Baldwin SR-4® Pressure Cells let us measure remotely all pumping along 670-mile 'Big Inch'"

Reports a leading pipe line company: "We're using safe, accurate, corrosion-proof SR-4 Pressure Cells to control remotely all pumping along a new 22 inch crude oil pipeline. This 670-mile pipeline uses ten pumping stations, all controlled remotely through a telemetering system out of one control station hooked up to SR-4 Pressure Cells at each of the other stations. The SR-4 System gives us these important benefits:

"High Accuracy—Their dependable accuracy makes frequent calibration of the SR-4 Pressure Cells unnecessary. They are not affected by pressure pulsations of the pumps.

"Remote Indicating-Remote indicating

SR-4 cells make it possible to control all ten stations through one.

"Corrosion Protection—The SR-4 cells are corrosion-proof preventing costly replacement and maintenance shutdowns of the lines.

"Explosion-Proof—The SR-4 cells have no moving parts to create a frictionspark fire hazard."

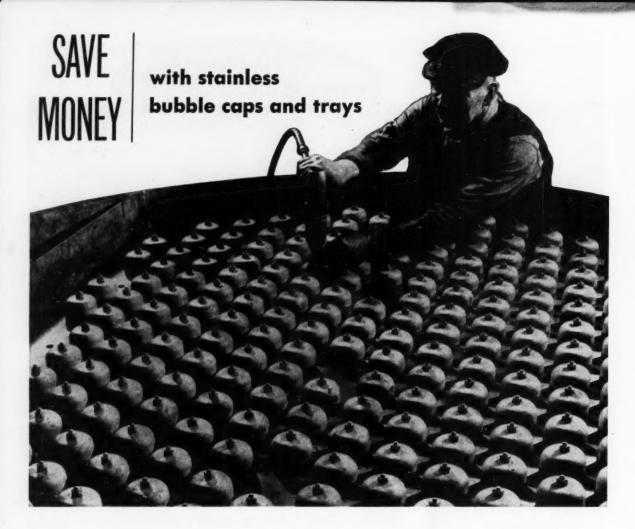
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Here's a stainless steel bubble tray with stainless bubble caps. More and more chemical plants find that they can't afford to be without stainless steel in their vapor-liquid contact equipment.

Where there are corrosive conditions, stainless steel reduces costs because it stands up under high temperatures and many corrodents. Of course, you have to use the *right* stainless for best results. Armoo makes all standard stainless steels and special grades as well.

Less "Down" Time

Stainless steel caps and trays reduce down-time consumed in replacing parts worn by corrosion and erosion. They save on cleaning time too. The smooth, hard surfaces of Armco Stainless Steel caps and trays help where there are sediment difficulties. The thinner sections made possible through the use of sheets and strip also reduce costly downtime because they cool quicker and heat up faster.

Easier Handling

Vapor-liquid contacting components, made of Armco Stainless Steel sheets, strip and bars, are relatively light weight. This means easier installation and faster inspection. Manufacturers can ship new towers safely with trays and caps completely installed because of the light weight and high strength of the stainless steel parts.

Write for Information

For names of manufacturers of stainless steel trays and caps and information on Armco Stainless Steels, just write us at the address below.

ARMCO STEEL CORPORATION

5174 CURTIS STREET, MIDDLETOWN, OHIO



CHEEFER CITY . ARMED CONTRACT & METAL BENDRICK INC . THE ADMINISTRALIANAL CORPORATION

NOW!

A GREAT NEW LINE OF ULTRA-HIGH PRESSURE VALVES

HERE'S WELCOMED NEWS for American petroleum and chemical industries. Now available for the first time is a great new line of Ultra-High Pressure Valves that bear the Powell name and maintain the Powell standards of precision.

These outstanding Ultra-High Pressure Valves (1500 to 15,000 lbs.) were developed by Powell for ammonia syntheses and other processes, and designed for sub-zero to extremely high temperatures. Available with butt and socket welding ends, flanged ends with ring joint or lens type facings, and in a wide variety of steels and alloys.

We'll be pleased to tell you more about this great new line of valves—and to help you with your petroleum and chemical valve problems. Finding sound solutions is a specialty at Powell, who probably have solved more valve problems than any other organization in the world. Write direct to Tke William Powell Company, Cincinnati 22, Ohio.

High pressure angle valve

High pressure angle check valve



CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves

108th year

Have You Overlooked This Way To Save Money On



Possy from wollded pressure versels 7' dia, by 36' long tabricated

BETTER CHECK!

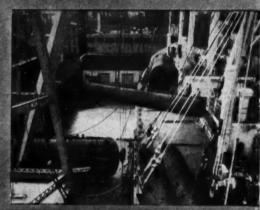
Check to be sure you're obtaining pressure

vessels of highest integrity at advantageous prices. First—sek a Possy Iron Works engineer to call. He'll describe our installations in your field. Then before you place your next order for pressure vessels—be certain to get a Possy Iron Works estimate.

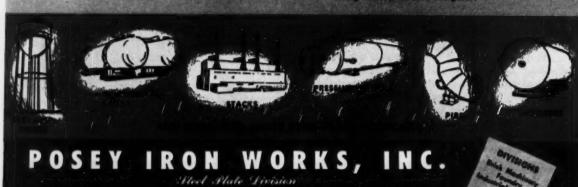
Long field experience teaches Posey Iron Works' engineers to think in down-to-earth terms. Their "hard-boiled", practical approach helps especially while your job is in the planning stage. That's when a Posey Iron engineer has his best chance to pare your costs. That's the time to call him in.

Posey from fabricates both large and small vessels ... for both liquids and gases ... in steel and alloy steels. All equipment is tested to considerable excess over normal working pressures. All stendard codes are met including ASME: API-ASME.

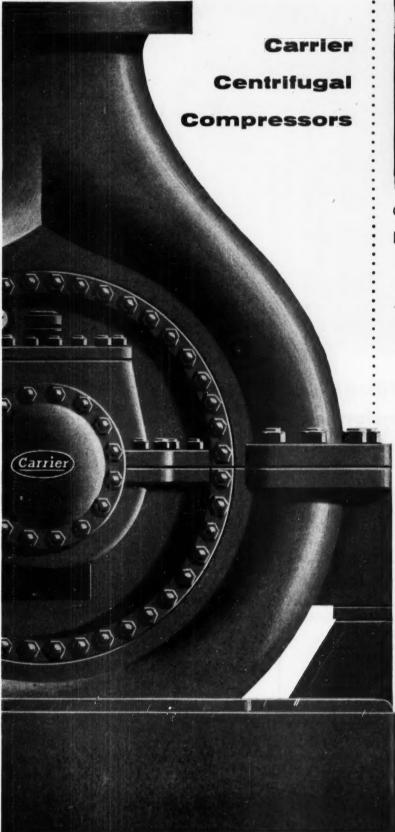
Better check your "pressures" with Possy front

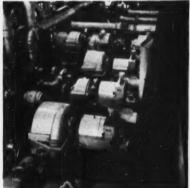


Possy from Yenks for obligation overcom-



LANCASTER, PA.
New York Office: Graybar Building





on the job at

Eastman Kodak

21 Carrier Centrifugal Refrigerating Machines, with a total refrigeration capacity equal to the cooling effect of melting 30,000 tons of ice a day, are on the job at the Kodak Park Works in Rochester, N. Y. This 550-acre plant, manufacturing photographic films, papers and chemicals, has one of the world's largest refrigeration installations.

Carrier makes a complete line of centrifugals for gas compression and refrigeration—up to 10,000 hp in a single unit. There are hundreds of these dependable, efficient Carrier machines on the job at dozens of chemical plants and refineries across the country—such as Reichhold Chemicals Company, Cities Service Company, The Texas Company. May we assist you?

If you'd like a copy of our informative booklet,

> "Centrifugal Compressors for Industry,"

please call your nearest Carrier office. Or write to Carrier Corporation, Syracuse, New York.



centrifugal compressors refrigerating equipment

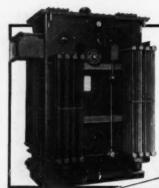


Now, Wagner Noflamol (non-inflammable liquid-filled) Load Center Transformers are available in a new, improved close-coupled design, as well as in the standard throat-con-

nected design. These transformers can be flush-mounted with any make of switchgear to form a neat, compact, streamlined unit substation for modern industrial service.

Wagner close-coupled transformers are available in ratings from 500 through 2000 kva. They are carefully designed to meet your distribution requirements.

Look to Wagner for better transformers that assure a continuous, dependable flow of power. Your nearby Wagner engineer will be glad to help you solve your loadcenter problems. Call the nearest of our 32 branch offices, or write us.



Wanner

Throat-Connected Unit Substation Transformers

For outdoor installation, or for applications where it is desirable to locate the transformer away from the switchgear, Wagner can furnish these liquid-filled transformers in ratings to 2000 kva, 15 kv and below. Bulletin TU-13 gives full information.

Wadner Electric Corporation

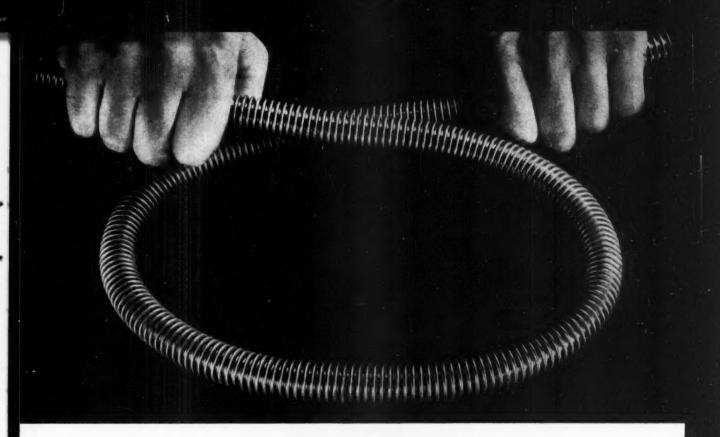
WAGNER ELECTRIC CORPORATION
6407 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

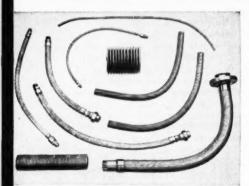
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS
TRANSFORMERS

INDUSTRIAL BRAKES

AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC





WIDELY USED in processing of food and chemicals, American Flexible Stainless Steel Tubing is engineered to design requirements.



OPEN PITCH tubing for conveying corrosive liquids and gases, exhaust, hot air, etc. under infrequent movement conditions.



STAINLESS STEEL BRAID gives extra strength to tubing for high pressure service.



CLOSE PITCH tubing for extra flexibility, frequent movement, vibration, compressions, extension, etc.



ASSEMBLIES, complete with fittings attached, manufactured to your specifications.

American Flexible Stainless Steel Tubing meets tough design "specs"

- Conveys corrosive gases and liquids at high temperatures—high pressures
- Stands up under continuous flexing
- Absorbs severe vibration
- Compensates for misalignment
- Takes movement and offset motion

Today industry looks to "American" - a leader for over forty years in the manufacture of flexible metal hose and tubing - as a dependable source for flexible stainless steel tubing. This tubing is specially engineered and manufactured to give desired flexibility with greatest durability.

· American Flexible Stainless Steel Tubing is annularly corrugated, and is

made in both open and close-pitch construction. It is available in Types 316 and 321, ranging in size from 1/4" I.D. through 4" I.D. Assemblies are made up with or without wire braid covering to meet most industrial working pressures. American stocks a line of standard fittings. These are attached to the tubing in our own plant by Heliarc welding or silver brazing.

Send us details of your connector problem. "American" engineers can help you solve it.

MEREVER CONNECTORS MUST MONE

flexible metal hose and tubing an ANACONDA® product



BOOKLET!

Gives engineering data on construction and of American Flexible Stainless Steel Tubing. Includes in-formation on fittings. Write today for your free copy.

The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.

Please send me Bulletin STC-1 on American Flexible

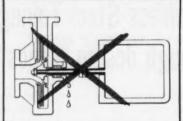
Stainless Steel Tubing.

ZONE . . . STATE .

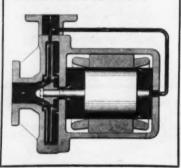
"CANNED ROTOR" PUMPS PAY OFF IN LOW UPKEEP COSTS, NO FLUID LOSSES

UNIQUE CHEMPUMP DESIGN SAVES TRICHLORETHYLENE USER \$45 A DAY

Philadelphía, Pa. Officials of a large electrical switchgear manufacturer recently stated that \$45 per day savings of trichlorethylene resulted from installing a Model CF Chempump on a distillation-type degreaser. Fluid losses with the ordinary centrifugal previously installed averaged 25 gallons a day. "On top of this," they stated, "we had to repack the pump every two days. We'd tried all kinds of packing, some of them very expensive-but without luck. Since installing the Chempump, we haven't lost a drop of solvent, and there has been absolutely no maintenance."



Design secret of the Chempump lies in combined construction of pump and motor, which eliminates seals, stuffing boxes, lubrication, long external shafts, etc. The Chempump allows pumped fluid to enter rotor chamber; a corrosion resistant liner isolates stator windings. Chempumps are available in sizes from ½ to 7½ horsepower, and in a wide variety of construction materials.



NUCLEAR SERVICE REQUIREMENTS SPUR LEAK-PROOF PUMP PRODUCTION

Less than two years ago, only one company in the country was producing and marketing a canned-rotor pump. Today, spurred on by the atomic energy program, half a dozen firms are at work on models for atomic-powered submarines, nuclear energy central stations, even atomic-powered aircraft.

To the man in the chemical process industries, all this is good news, because canned-rotor pumps can't



H. T. White and D. P. Litzenberg (left), developers of the first practical seal-less "canned-rotor" pump. On the desk are plans for an extreme-pressure, extreme-temperature design.

PUMP SERVICE POLICY ENDS MAINTENANCE PROBLEMS

To reduce process downtime, many plants purchase a spare pump for every two, three, or five pumps installed, depending on circumstances. We feel this is a good policy, since downtime is limited to the time required to install a spare.

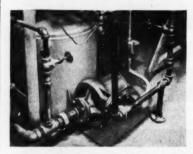
But what about repairing the faulty pump? Are proper spare parts on hand? How about maintenance department scheduling? The answer to these and other problems is the Chempump Service Policy. Any Chempump, damaged or inoperative for any reason—including improper pump application—will be repaired at the factory and returned to the customer with a new pump warranty. The pump is completely rebuilt, inspected and tested by factory experts . . . and the cost is moderate.

This service policy stops repair headaches, cuts spare parts inventory, and in effect, places a new pump on your shelves in short order. leak. They require no shaft seals or stuffing boxes, maintenance is practically nonexistent. And leakage losses, high maintenance costs are two of the biggest headaches centrifugal pump users face.

Canned-rotor pumps came about through the efforts of two young Philadelphia engineers, now officers and directors of the Chempump Corporation. Working on principles developed before World War II, they did further research and engineering, and in 1947 began production of a seal-less, canned-rotor pump.

Even while tooling up for production of this first model, the two designers were planning variations for specific applications in the chemical process industries. Pumps were built to handle extreme temperatures and pressures as well as a variety of corrosive fluids. The pumping requirements of chemical processors were carefully studied, and steps taken toward standardization of designs to meet those requirements.

1952 saw the formation of the Chempump Corporation to build canned pumps for the chemical process industries. Experience gained from nearly 15 years of laboratory and field testing went into the design and production of products offered by this corporation. First in the field of canned-rotor pumps, Chempump is also first with pumps tailored specifically to the chemical processing industry.



Chempump handling condensate under extreme vacuum for large Eastern chemical manufacturer. Air contamination would render system inoperative.

Chempump

CHEMPUMP CORPORATION
1322 EAST MERMAID LANE • PHILADELPHIA 18, PA.



This Allis-Chalmers four-stage centrifugal blower supplies 24,000 cfm to the catalytic cracking tower of an eastern refinery on a 24-hour-aday basis, month in and month out.

the features above.

For highly dependable, low maintenance air and gas handling equipment, as well as motors and control, call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4471

ALLIS-CHALMERS



HOW HERCULES HELPS...

Most businesses are helped today by Hercules' business ... the production of synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products, and many other chemical processing materials—as well as explosives. Through close cooperative research with its customers, Hercules has helped improve the processing or performance of many industrial and consumer products. We welcome the opportunity to work with you.



BEAUTIFUL BUT TOUGH — "Saucy Walker" greets "Mary Hartline", famed star of TV. Both dolls are members of the ever-popular Ideal Toy family. Molded with Hercules Hercocel® Cellulose acetate, the dolls have that combination of beauty and durability that spells increased sales . . . happy children . . . satisfied parents.



ONE PAINT IN A HUNDRED—Toronto's new \$50,000,000 subway is modern in every way, including its glistening tile walls and brightly painted ceilings. For the ceiling, a paint was needed that could resist high humidity. More than 100 were tested and a paint based on Hercules Parlon® (chlorinated jrubber) selected. On all types of surfaces, interior and exterior, Parlon paints are providing outstanding service at lower long-term cost.

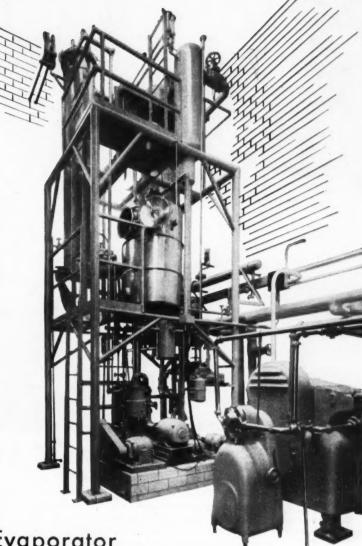


FOR A WHITE HOT RECIPE—Pouring moiten metal to produce castings weighing 30 tons or more places a heavy demand on the sand. Molds and cores for steel and cores for iron "stay put" when bonded with Truline* binder. Yet cores are easily removed when metal has set. And Truline means cores can be baked in half the normal time, preventing foundry oven bottlenecks; reducing man hours per ton.

HERCULES

HERCULES POWDER COMPANY

952 Market Street, Wilmington 99, Delaware Sales Offices in Principal Cities



TRENTWELD tubing gives...

- *corrosion resistance
- *long service life
- *ease of cleaning
- *product protection

in Lo-Temp Evaporator





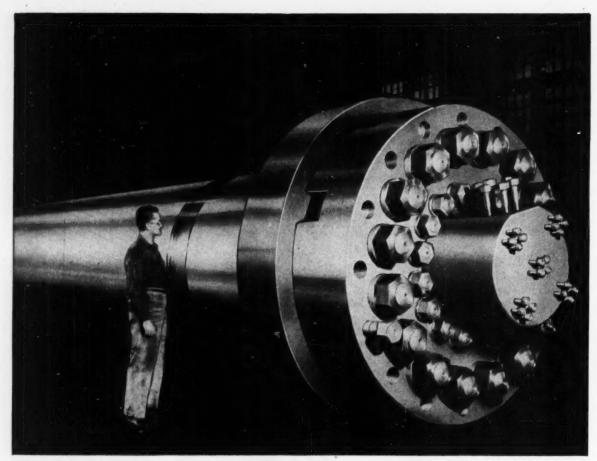
This Mojonnier Lo-Temp Evaporator is designed to remove water from heat-sensitive liquid foods, pharmaceuticals and chemicals, at temperatures as low as 40F. Heart of the evaporator is made of nests of TRENTWELD stainless steel tubing.

TRENTWELD tubing is an ideal choice for this application. For TRENTWELD stainless tubing resists the corrosive attack of both the product itself, and the ammonia refrigerant pumped inside the tubing. And TRENTWELD stainless is inert... protects the product from contamination. But that's not all—TRENTWELD comes-clean with an absolute minimum of effort.

So when you have a tubing application check first with TRENT. You'll find the largest assortment of sizes and finishes in the industry . . . standard sizes from ½" to 40" O.D. — larger sizes on special order. And remember, TRENTWELD stainless and high alloy tubing are products of tube mill specialists. You can't buy better than TRENTWELD.

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)



PRESSURE STARTS Right AT THE BEGINNING!

Product—Converter
Working Pressure—
4,500 P. S. I.
Inside Diameter—
45"
Tensile Strength—
75,000 P. S. I.
Material—ChromeVanadium Steel
Closure—Bridgman
Installation—Union
Carbide and
Carbon Corp.
Texas City, Texas

Midvale pressure vessels are right from the start. Designed right in cooperation with customer's engineers. Made right from the pouring of the steel to final machining. Proved right by extensive sonic, hydrostatic, strain-gage and X-ray tests.

This big brute is an example of Midvale's vast experience and facilities and is the result of complete cooperation in design and building with the engineers of Union Carbide and Carbon Corporation.

This pressure vessel started as a 550,000 pound ingot of chrome-vanadium steel, poured by Midvale's steel making specialists. Then carefully

hollow forged to rough shape on 14,000 ton and 7,500 ton presses...hydrostatically tested at 9,000 P. S. I. for a working pressure of 4,500 P. S. I. It has been successfully operating for years at Texas City, Texas.

Forged steel converters, reactors, separators, autoclaves . . . any size or type . . . Midvale has the complete facilities and the experienced craftsmen to make them to withstand high pressures, high temperatures and resist corrosion. Next time your plans include pressure vessels get in touch with Midvale. Let our engineers work with you from initial design to final installation.

THE MIDVALE COMPANY-Nicetown, Philadelphia 40, Pa.

Offices: New York, Chicago, Pittsburgh, Washington, Cleveland, San Francisco

FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS



Why Automatic Sequencing of Batch Operations \$AVE\$ DOLLAR\$...

... because the Taylor FLEX-O-TIMER® Time Cycle Controller "does its own thinking" – takes care of as many as 36 operations automatically, thus saving operator man hours!



The Taylor Flex-O-Timer Time Cycle Controller

THIS dividend-paying instrument is the Taylor *FLEX-O-TIMER Time Cycle Controller. It provides precise, automatic timing of the sequence and duration of up to 36 processing operations involving temperature, pressure, mechanical motion, electrical energy or combinations. There are hundreds of applications throughout industry where this versatile controller can insure greater uniformity of

processing, save operator effort — both physical and mental—and save you money. If you say "yes" to any of these questions it will pay you to call in your Taylor Field Engineer now.

Q. Do you have batch processes requiring personnel to perform multiple operations in sequence with complete reliability?

A. The Taylor FLEX-O-TIMER Controller enables you to coordinate batch processes to meet the requirements of a continuous process. You don't have to rely on people to turn the valves or perform other operations at the right time; e.g., the regeneration of a contaminated catalyst bed in a continuous process. The FLEX-O-TIMER Controller will:—stop the process; clean out process fluids; backwash the bed—or burn out the impurities; put the unit back on stream. All this automatically and in accordance with the best practices.

Q. Are you faced with reprocessing and consequent costly waste if certain manual operations do not take place at the right time, in the right sequence and for the correct duration?

A. You eliminate the possibility of human error with this robot brain in control. You can depend on the FLEX-O-TIMER Controller to turn the valve, pull the switch or perform other operations—automatically; e.g., the molding of plastics or vulcanizing of golf balls.

Q. Can customer dissatisfaction ever be traced to variations in product quality due to processing irregularities?

A. Once you've developed the optimum time, temperature, pressure and other variables for a process you can be sure of repeating that process exactly, time after time; e.g., backwashing of filter beds in a continuous process. Result: You are assured of a uniformly high quality product—the secret of repeat business.

Q. Wouldn't you consider it a good investment if a completely automatic sequencing control system applied to your batch processes paid off in a year or less?

A. Many chemical plants have increased their profits by revamping their batch processes in this way, using the Taylor FLEX-O-TIMER Controller as the key instrument; e.g., the operation of hydraulic presses in removing excess chemical from fibrous materials; plastic press operation; dry ice molding; the lamination of plywoods; tire molding; the opening and closing of dump valves in paper pulp bleach cells; the batch hydro-genation of edible oils and fats.

Q. Why is this system so successful?

A. Because Taylor Instrument Companies have the necessary experience and know-how to apply instrumentation of this kind to the best advantage in many diversified industries. Taylor Engineers have acquired this skill through many years of working in the field with instrument men and engineers. Their knowledge is at your disposal. Why not write today! Also ask for Bulletin 98154. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Taylor Instruments
MEAN ACCURACY FIRST

COPPUS TURBINES

offer you
a choice of
packing
rings

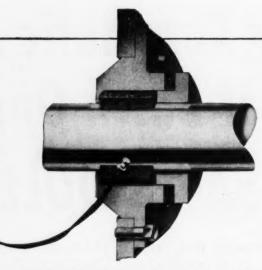


FIT TURBINE COSTS TO HORSEPOWER NEEDS

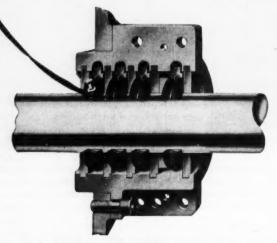
When you buy turbines rated close to your exact horsepower needs, you save plenty of money. That's because turbines are generally priced in proportion to their size. The wide range of sizes of Coppus Turbines promises purchasing economy for you from the 150 hp size down to the smallest. As for operating and maintenance economies, you get them, too, from such other features as: greater number of manually operated valves for individual control of steam nozzles; replaceable cartridge-type bearing housings and others. For complete details . . .



WRITE FOR BULLETIN 135 COPPUS ENGINEERING CORPORATION 232 Park Avenue Worcester 2, Mass. Sales offices in THOMAS' REGISTER



STANDARD METALLIC RING PACKING — Made of high grade asbestos cores encased in specially treated lubricated aluminum foil. Recommended as a low-friction, long-service packing for steam temperatures up to 850 F and back pressures up to 50 lb. Adjustable packing glands keep leakage at minimum. Easy access to packing rings.

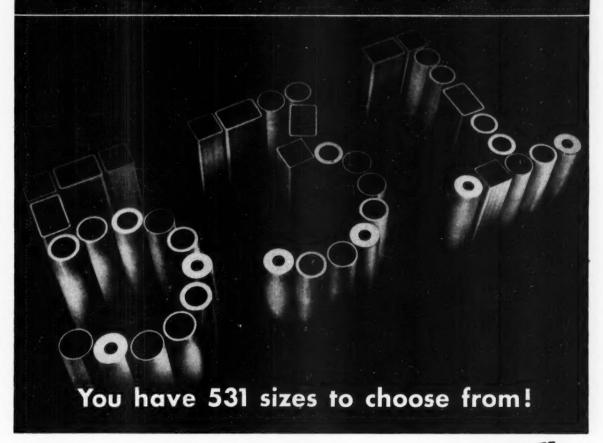


OPTIONAL GARBON RING PACKING — Consists of three carbon packing rings on the pressure side and one beyond the leak-off section. Each ring has three segments held together by a stainless steel garter spring. For back pressures up to 75 lb. Standard for vacuum or gas operation, or when leak-off is desired.

Heavy chrome plating on shaft at stuffing box is common to both types of Coppus packing.

COPPUS "BLUE RIBBON" URBINES

WHY IT PAYS TO BUY MECHANICAL TUBING FROM US



WE carry no less than 531 sizes of Shelby Seamless Mechanical Tubing and can fill orders promptly ... by the inch or by the carload. No matter what your tubing needs, we can supply you with the best for the job—tubing manufactured by the world's leading producer, National Tube Division of United States Steel.

Our experience in the field of tub-

ing applications has often saved large sums of customers' money—for it is sometimes possible to substitute a more economical type of tubing than you had planned to use.

We carry everything you need. Call us for: mechanical tubing, round and square, seamless and welded; boiler tubing, pressure tubing and pipe; stainless steel tubing, seamless and welded, and stainless pipe. TRIPLE

What you want When you want it At the right price

U. S. STEEL SUPPLY

DIVISION

General Office 208 So. La Salle St., Chicago 4, III



Warehouses and Sales Offices Coast to Coast



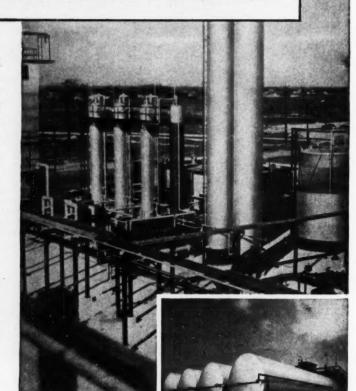
UNITED STATES STEEL

CLAD STEEL TANKS WHIP CHEMICAL CORROSION THREAT

A critical corrosion problem faced this chemical producer. In a plant that can process up to 100 million pounds of fats and oils annually, unsaturated acids and moisture would cause fatty acids to attack iron during storage. Presence of iron salts would threaten instability and as little as 30 to 40 parts of iron per million are enough to darken fatty acids. With lighter colors getting a premium price and output headed for high-grade consumer products, product quality had to be protected. The answer: economical clad steel equipment ended the danger of corrosion during storage, virtually eliminated iron pick-up.

Cooperative planning between the designers and equipment builder solved this problem. Stainless-clad steel was specified for four horizontal feed tanks, two settling tanks and two insulated cone roof storage tanks. Here a light layer of cladding provides the smooth, corrosion-resistant surface of more expensive solid alloy, while the low-cost carbon steel backing gives strength and rigidity. Integral and permanent bonding of cladding and backing prevents seepage of acid to the backing. Smooth contours and joints possible with clad permit easy cleaning and lessen the chances of contamination.

If you are looking for economical product protection, follow the profitable lead of this chemical producer. Call in your equipment builder *early* in your planning of new equipment. Working with your engineers and consultants, he can contribute his skill, know-how, and understanding of your field to give you the low-cost, long-lived clad steel equipment your process demands.



Economical stainless-clad steel tanks guard product quality. They reduce iron pick-up to prevent the discoloration of fatty acids by iron salts.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 678 Lukens Building, Coatesville, Pennsylvania.



KENS CLAD STEELS

STAINLESS-CLAD . NICKEL-CLAD . INCONEL-CLAD . MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

what's the ONE BEST

answer to your problem of...

... GRANULATING?

A rotary knife cutter is probably your one best answer to granulating problems. It usually produces particles of more uniform size than are obtainable through any other type of machine. On the other hand, Sprout-Waldron has sometimes used roller mills with proper combinations of roll corrugations and speed differentials for this task. The attrition mill often offers the most flexible and economical means of granulating because disc surface, speed of rotation, clearance between surfaces, and feed rate can be varied. And a crusher might be the answer if the material is somewhat friable and the end-product size justifies it.

The nature of the material and the end product desired determine the proper machine to use with the least possible cost. Perhaps in no other operation is experience so important. The control of particle size in a finished ground product and the holding of extreme fines to a minimum are fields in which Sprout-Waldron has had unlimited experience.

.. DEFIBERIZING?

Pulling rags apart into threads or ragged swatches, flocking sheet pulp, pulping wood chips, shredding leather, defiberizing old rubber tires, shredding jute—to name only a few widely scattered operations that can be classified as involving a defiberizing action—are applications on which Sprout-Waldron engineers and Sprout-Waldron products can combine to give you the one best answer. Each case must be investigated as to material and end results desired. And from such an investigation will come a recommendation that very conceivably can put you far ahead of your competition.

... PULVERIZING?

For many operations classified as pulverizing, Sprout-Waldron can supply the *one best* answer from a vast line of size reduction equipment. And if Sprout-Waldron doesn't have your *one best* answer, you'll be told who does have it.

For some pulverizing, hammer mills are often the answer, and Sprout-Waldron has an interesting and unique line of units that have solved many different processing problems by proper selection of hammers and screens. Many times attrition mills or roller mills furnish the one best answer, and where a fine, floury texture is particularly important, burr stone mills can sometimes be the solution.

Each size reduction problem has a solution that is the one best answer and that can be determined by submitting the problem to Sprout-Waldron. You will receive a recommendation based on the combined experience of men working constantly with size reduction problems and backed by successful case history files of processing solutions, and laboratory processing test data. If Sprout-Waldron equipment does not meet your needs, you'll be directed to a manufacturer who can supply the one best answer. Let Sprout-Waldron study your size reduction problems without cost or obligation.



SPROUT-WALDRON

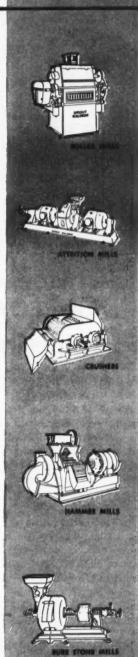
- Manufacturing Engineers Since 1866

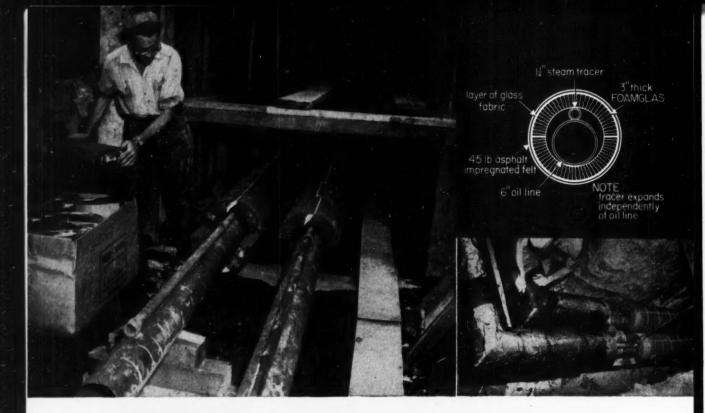
Equipment of SIZE REDUCTION - MIXING & BLENDING - PELLETING & CUBING - BULK MATERIALS HANDLING - PRODUCT CLASSIFICATION

15 LOGAN STREET . MUNCY, PA.

CHEMICAL ENGINEERING—December 1954







Con Edison engineers report:

"We chose FOAMGLAS for underground pipe insulation because it stays dry!"

Consolidated Luison Company's engineers are using waterproof FOAMGLAS to insulate underground heated fuel oil lines at their Astoria, N.Y., Generating Plant. They report: "In this underground installation, our first concern was to get an insulation which would resist moisture and give consistent insulating results under damp conditions. We chose FOAMGLAS because of its moisture resistant qualities."

Con Edison's engineers continue: "Our choice of FOAMGLAS involved maintenance considerations, too. Replacing or servicing insulation in our underground installation would involve considerable

expense. We feel that FOAMGLAS will help us hold maintenance expense to a minimum."

It makes sense ... if Con Edison can achieve such benefits from FOAMGLAS under difficult operating conditions, you can profit by using this unique, cellular glass insulation. FOAMGLAS laughs at the moisture that cuts efficiency of other insulations ... and is fireproof and acid-proof, too.

See our catalog in Sweet's Catalog Files . . . or send today for your sample and our booklets describing the use of cellular, stay-dry FOAMGLAS to insulate piping, tanks, and other equipment.

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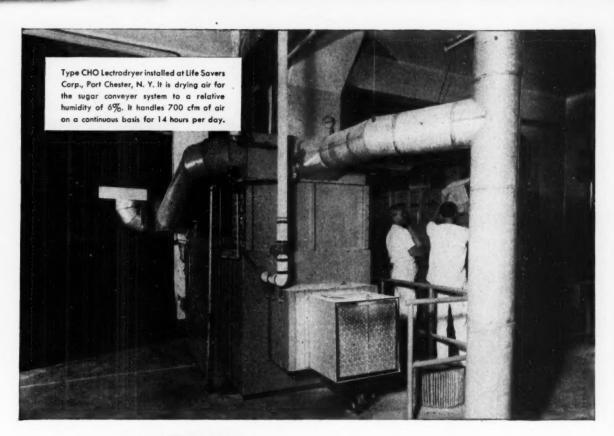
FOAMGLAS°

the cellular, stay-dry insulation





Pittsburgh Corning also makes PC Glass Blocks



LIFE SAVERS find ... "drying a must in handling sugar"

"Before our Lectrodryer* was put into service, we had constant trouble with sugar loading up with moisture and jamming the stainless steel conveyer pipes," says Mr. J. H. Ford, Plant Engineer at Life Savers Corp.

Now conveyer air feeds through the Lectrodryer where it is dried to 6% relative humidity. Such dry air delivers the sugar dry, regardless of outside weather.

This same protection can be applied to any moisture-absorbing substance. Surround it with sufficient dryness to keep it dry and workable in storage, processing, conveying, packaging, etc. There are Lectrodryers serving all of these needs. These machines can reduce dewpoints in air and other gases to as low as -100° F... even at pressures as high as 6000 psi.

Write for Because Moisture Isn't Pink. This free booklet describes Lectrodryers and tells how many industries are using them to keep air, gases and organic liquids dry. Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

LECTRODRYERS DRY
WITH ACTIVATED ALUMINAS

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LECTRODRYER

Announcing New, Re-Designed ABBRITATE

HEAVY DUTY
PLUGS & RECEPTACLES

pressure connectors; no soldering unless you prefer to do it.

bly; comes out in one piece—just remove 2 screws.

receptacle interiors; no machining;

plug adaptability; takes any size portable cable up to full 30 amp. capacity.

Circuit-Breaking Features

Make Arktite Safe at Full Load

Without Disconnect Switches

Each contact is insulated in a separate chamber. Ares formed while making or breaking circuit are snuffed out in arcing chambers by pressure-deionization and lack of oxygen. No chance of flash-over even if break is made at full load. With grounding contacts longer than load contacts, plug and tool are grounded before circuit is made and after it is broken.

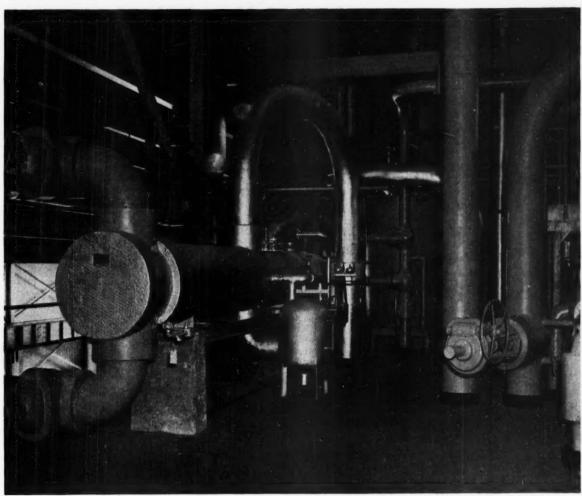
New Arktites now available in 30 amp. size – 2-pole, 3-pole and 4-pole styles. Fully interchangeable with old Arktites – same economical price.

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CONDULETS . FLOODLIGHTS . TRAFFIC SIGNALS . AIRPORT LIGHTING



This evaporator-condenser unit in a modern power plant is insulated with "Featherweight" 85% Magnesia.

"Featherweight" 85% Magnesia insulation conserves heat and dollars

"Featherweight" 85% Magnesia (85% basic carbonate of magnesia and asbestos fiber) effectively insulates piping and equipment with temperatures up to 600° F. Used with a primary layer of K&M Hy-Temp Insulation (Diatomaceous Silica), the combination is effective up to 1900° F. The application of these two layers—with staggered joints—eliminates the heat loss that normally occurs when expansion causes the joints to open in single layer installations.

These K&M insulations last the life of the equipment

they serve. They withstand moisture, vibration and frequent temperature changes.

New and now available is "Featherweight" Water-Resistant Magnesia Insulation for temperatures up to 450° F. It is used underground where severe water exposure may damage the insulation or on indoor steam heated lines and equipment where high humidity and moisture are present.

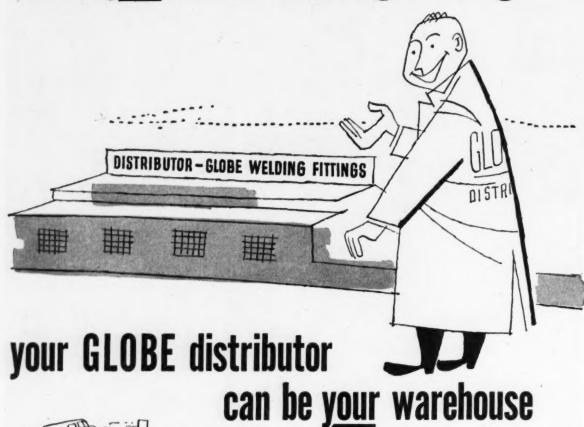
For more information on these heat-saving, moneysaving K&M insulations, contact your K&M distributor who is an experienced applicator. Or write directly to us.

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Among the many advantages you get by dealing with your Globe Welding Fittings distributor is the fact that you can hold inventory to a sensible minimum and conserve stockroom space.

That's because he carries a wide range of types and sizes of welding fittings in stock. Thus, your welding fittings supply is no farther away than the nearest phone. At the same time you can simplify much of the paperwork usually required for extensive inventory control, purchasing and bookkeeping.

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Modern Safeguards—Brink's for Money, Bailey for Process Materials

Are Your Process Materials Guarded As Well?

HERE'S HOW TO PREVENT SPOILAGE AND WASTE...

To avoid waste of valuable process materials and finished products, process rates and conditions must be accurately measured and controlled. That's where Bailey Meters, Analyzers and Controllers can help you to improve the efficiency of your plant.

Take flow for instance. Bailey Meter Company offers a complete line of flow measuring and controlling equipment for applications ranging all the way from high pressure steam to low pressure gas. We measure flow in pipes, open channels, ducts, furnaces, smelters, kilns, ovens, dryers.

When you call Bailey Meter Company, you get the help of years of experience as well as recommendations from a wide selection of measuring and controlling devices.

Your local Bailey Engineer is as near as your telephone. He has the experience and the equipment necessary to set up an effective guard for your process materials.

P-26



AREA TYPE FLOW METER

Transmitter goes Into 1, 2 or 4 inch pipe line like a valve and transmits flow measurements electrically to recorder in remote location.

Measures oil and other clear liquids under static pressures up to 600 psi. Minimum range 0 to 1200 lb. per hour, maximum range 0 to 9600 lb. per hour.

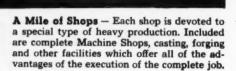
BAILEY METER COMPANY

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Process Controls TEMPERATURE : FLOW PRESSURE : LEVEL GAS ANALYSIS : RATIO



A half mile of ressure ve



pressure vessels

These are two of seventy — over ½ mile — of 38½-foot vacuum tank casings built to meet the quality requirements of a well-known chemical maker.

The buyer also benefits from many savings made possible by Newport News extensive heavy fabrication equipment and the sixty years experience in using it.

Do you plan installations of heavy production equipment? You can command the services of Newport News for weldments of corrosion-resistant, alloy and clad metals in almost any size or shape, plus the required engineering background and complete welding and stress-relieving skills.

It will pay you to get the facts, shown in Facilities and Products. As you glance at its photos and brief captions, you'll see why Newport News can turn out — at low cost — specialized heavy equipment for chemical plants.

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STEEL FALK Motoreducer

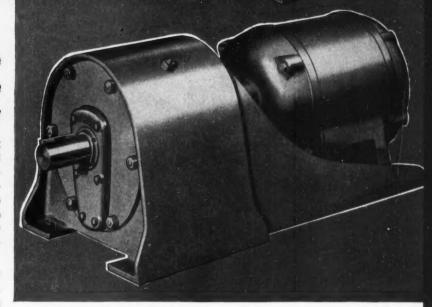
you can interchange motors in minutes... on the job!

Fast, easy maintenance gives savings in time and money

With the all-steel, All-Motor type FALK Motoreducer . . . the only complete and compact motorized reducer with a separately mounted, resilient Steelflex coupling-connected motor... you can replace or interchange motors, or even parts, in minutes—on the job, without long and costly "down time"! Ratios can be changed (within capacity) without motor modification.

Any make, speed, or type of standard foot-mounted motor within the unit's AGMA rating is usable without modification on this All-Motor type Motoreducer. Motors with variable speed drive arrangement can be used, if desired. No "partial" motor or special shaft is required in event of motor replacement—simply use a complete motor, available for quick delivery from factory or local stocks without expensive delays.

Add to these exclusive maintenancesaving advantages the FALK "In-built" Factors, described at the right, and you have an unbeatable combination of quality, application adaptability, dependability, long-range economy, and dollar-fordollar value. Write for Bulletin 3104.





Every FALK Motoreducer has these "In-built" Factors—

Positive Lubrication. Large sump capacity ... oil-tight construction assures clean lubricant ... direct dip of revolving elements provides positive lubrication at all speeds.

Wide Speed Range. Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

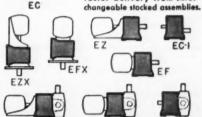
Streamlined Inside and outside. Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

Sealed Housings. Dual closures and oneway vents keep oil in, dust and moisture out. Units are splash-proof, leakproof, dustproof. Precision Geering. Heat treated alloy steel, precision cut and shaved helical gearing throughout . . . quiet-operating crown shaved pinions . . . taper bored gears for easy ratio changes.

All-steel Housings. Unbreakable, strong, rigid. Generous everhung load capacities provided by wide bearing spans, large shafts and bearings.

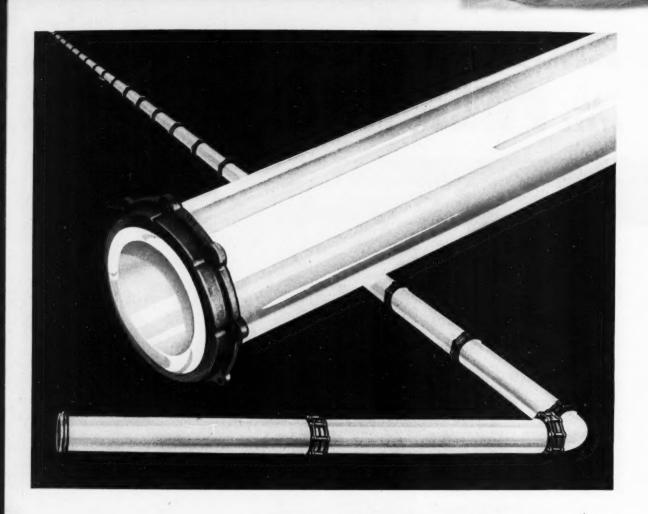


The basic E design permits maximum use of stardardized parts . . . closer control over materials, processing, inspection and assembly . . . resulting in faster delivery from inter-



FRANKE ... a good name in industry

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For some applications ONLY CHEMICAL CERAMICS will do

For only chemical ceramics will resist all acids, alkalies and all solvents (with the exceptions of fluorides and hot caustics). White chemical porcelain, in particular, offers important processing advantages. In addition to its chemical inertness, white chemical porcelain is completely non-toxic and noncontaminating. Its smooth glazed surface makes cleaning a matter of minutes. It can be fabricated in one-piece construction into vessels of practically any shape and in sizes from a thimble to a thousand gallon tank. Many items of equipment, such as pipe, valves, fittings, sinks, filters and storage vessels are standard items carried in stock and ready for immediate shipment. Other items can be fabricated on short notice.

The United States Stoneware Company has been one of the world's principal producers of chemical ceramics for more than ninety years. Continual research and im-

proved manufacturing techniques give today's chemical ceramics characteristics far superior to those of even a few years ago: better heat-shock resistance, higher mechanical strength, closer dimensional tolerances.

Better take a fresh look at chemical ceramics. It may pay you well.



499-D

Other Corrosion-Resistant materials manufactured and fabricated by U. S. Stoneware and its affiliated companies, include: TYGON Plastics, Duralon Resins, natural and synthetic rubber products, lead-lined equipment, adhesives and organic bonding agents, acid-brick and cements, and sintered metallic oxides.

DECEMBER Chementator

• Carbide of Canada has gotten into petrochemicals by buying Dominion Tar & Chemical's \$11 million, 30-million-lb./yr. ethylene glycol plant at Montreal East. A polyethylene unit will be added.

◆ Long rumored, Consolidated Mining & Smelting has confirmed option of land near Portland, Ore., for a \$20 million, 200 ton ammonia-urea plant that may require 25,000 kw. Unit was first set for Calgary, Alta., but fear of higher U. S. tariffs caused site shift.

Acetaldehyde coming from impure acetylene

Next year a new process for making acetaldehyde directly by reacting acetylene and water will get its first commercial test. Developed by Montecatini Co. of Italy, it resembles the method used by Carbide & Carbon at Niagara Falls, N. Y., but incorporates one standout difference: the acetylene can contain significant amounts of carbon dioxide.

One of the deterrents to use of this type of direct process has been that in the U. S. it's considered necessary to start with 99.5% pure acetylene. This necessitates costly removal of the CO₂ normally co-produced when making acetylene from natural gas.

Montecatini says it has bypassed this problem and makes no attempt to separate out the CO₂ until after the main reaction has been carried out. All the work on the process to date has been in a pilot plant, but the firm has now started to build a unit at Novara, Italy, to turn out 33 tons a day of acetaldehyde (99.5% pure). It's expected to start up in the second half of 1955.

Here's how the process works: Acetylene is manufactured via the Montecatini version of the Sachsse process (partial oxidation of methane). Higher acetylenes also produced are eliminated, presumably by scrubbing with a paraffinic oil under pressure. The rest of the reaction product is then absorbed in a solvent under pressure at low temperature. Fractionation follows.

Two main gas streams are recovered, one containing acetylene and CO₂, the other made up of

carbon monoxide and hydrogen, already compressed to 12 atm., which is used to make methanol.

Acetaldehyde is produced by catalytically reacting the acetylene-CO₂ stream with water. Scrubbing with more water removes the acetaldehyde and addition of aqueous potassium carbonate takes out the CO₂, which is later recovered.

In the Novara plant, the daily charge will be about 3.2 million cu. ft. of methane and 1.9 million cu. ft. of oxygen. In addition to the 33 tons of acetaldehyde, the plant will make 230,000 cu. ft. of anhydrous CO₂, and 5.3 million cu. ft. of a CO-H₂ mixture for conversion to 77 tons of methanol per day.

Oil from shale gains momentum

First U. S. firm to go into commercial production of petroleum products from oil shale will most likely be Union Oil of California. It's no longer a question of whether the company will do it, but when and how.

Six Union vice presidents, headed by W. L. Stewart, Jr., have gone to Rifle, Colo., to begin a six-month study of how the company can best exploit its shale holdings (estimated at 5 billion bbl.). Before leaving, Stewart said his firm has definitely decided to build, by itself, a commercial shale-processing plant in Colorado.

As to plant size, Stewart said only that Bureau of Mines' experience showed that a 25,000 bpd. unit was the smallest that makes sense.

(Continued on next page)

The committee's aim, of course, is to settle on such major details as size, cost, timing and products. Also included will be a close look at how population and market trends would affect a shale oil program. But with petroleum exploration costs soaring and with the very strong prospect of decreasing the cost of shale oil extraction, Union definitely feels that now is the time to make its big move.

Antibiotic patent fight rages

Claims and counter-claims are swirling around tetracycline, a relatively new broad-spectrum antibiotic believed by many to be the best yet for some uses because it produces few adverse side effects.

Rumblings of the impending battle came early in the product's history when three companies—American Cyanamid, Chas. Pfizer and Heyden Chemical—all claimed the original discovery. Cyanamid quickly improved its position by buying the drug division of Heyden.

Still another firm then entered the fray—Bristol Laboratories. Cyanamid has filed suit against Bristol for infringement of its 1949 patent covering chlorotetracycline (Aureomycin). Bristol denies the charge and says the suit will not affect its production and sale of the drug since "the ultimate issuance of a patent on tetracycline is still open."

So the whole affair is now in the hands of the Patent Office. And because the matter is so complicated it's not unlikely that no company will get an exclusive patent. Perhaps, say some trade authorities, all three will have to license each other.

Potash makers get new competition

Despite the current surplus of refined potash both here and in Europe, four American firms are proposing to open up still more potash production facilities near Carlsbad, N. M. All are newcomers to the industry.

Freeport Sulphur Co., New York, and Pittsburgh Consolidation Coal Co. have started negotiations on a joint \$16 million project to mine and refine 240,000 tons of potash annually. Freeport has been proving leases in the area for three years. And in another joint venture Kerr-McGee Oil Industries of Oklahoma City and the National Farmers Union, which started core drilling in the area over a year ago, have agreed to develop potash holdings valued at more than \$100 million.

Major U. S. potash producers might well be viewing these two projects with concern. Three of them wound up the last fertilizer year (ended May 31) with potash in storage. The other two cut back production during the year to avoid having to build more warehouses. Total output was nearly 2 million pounds.

The oversupply, which is the first ever in this country, was certainly caused partly by high European production. In the 1953-1954 season Western Europe had an exportable potash surplus totaling over 1.1 million pounds. And with cheaper labor, these countries, and even some behind the Iron Curtain, are underpricing U. S. producers.

New pesticide tolerances proposed

Marking the first application of the new Miller pesticide chemicals amendment (Public Law 518, Chementator, June 1954), the U. S. Dept. of Health, Education and Welfare has issued a proposed list of tolerances and exemptions for 26 common pesticides. Chemicals covered include, among others, aldrin, arsenates, DDT, BHC, fluorine compounds, parathion and toxaphene.

Since the tolerances are based on 1950 hearings and don't take into account more recent technological advances, 60 days are allowed (until Dec. 20) for interested parties to file exemptions.

Applications for tolerances on any other pesticides, new or old, will also be processed under the Miller amendment as new data is supplied. And it's important to note that zero tolerances will be set if safety data presented are not sufficient.

Under the Miller law, the Secretary of Agriculture certifies whether a pesticide is useful in agriculture before the Secretary of Health, Education and Welfare acts on a petition to set up a tolerance for it. The law also delineates procedure for appointment of advisory technical experts.

Totally new adsorbent unveiled

After several months of test marketing, Carbide's Linde Air Products Co. has finally taken the wraps off a brand new group of unusually selective adsorbents called Molecular Sieves (Chementator, July 1954). Test results, both laboratory and commercial, promise big potential uses varying from drying of both liquids and gases to separation of very close-boiling hydrocarbons.

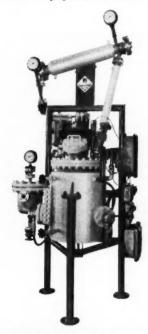
What Linde's actually done is open up a new concept in commercial adsorption. Most adsorbents function by differences in volatility. But these new products rely on differences in molecular

(Continued on page 108)

need a packaged Pilot Plant?

Now you can choose from a line of standard models... with internal contact surfaces of stainless steel...in capacities of five, ten or fifteen gallons...heated by steam, gas, or electricity. Each is equipped to handle a wide range of temperatures, pressures, rates of flow, and other physical variables.

Beyond this "standard" flexibility, each model can be readily adapted to fit even more specialized needs. By checking this line first, you can save original design cost and cut engineering and delivery time.... Here are two pilot plants and an autoclave already tested "on the job"...



15 GALLON PILOT PLANT

Design pressure for all vessels, jackets and piping 150 PSIG and full vacuum. Internal contact surfaces stainless steel, ground smooth.

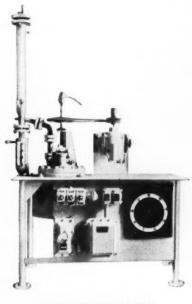
KETTLE: Jacketed sides and bottom for cooling and Dowtherm heating. Reactor designed for 700°F. Variable speed agitator.

CONDENSER: Removable core type. Water cooled shell.

DECANTER: Removable top head.

RECEIVER: 5 gallons capacity. Removable top head.

INSTRUMENTATION: Temperature recording controller and pressure indicator on reactor. Indicators for pressure, liquid level, temperature on reactor jacket. Other indicators on condenser, decanter, receiver. Flow indicator in condenser discharge piping.



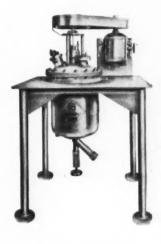
5 GALLON DISTILLATION PILOT PLANT

Designed as a complete packaged unit for alkyd resin experimentation. Active surfaces of stainless steel, ground smooth.

REACTOR: 150 PSIG design pressure. Internal cooling cylinder. Thermostatic controls. Variable speed agitator with hollow shaft for injection of gases into material.

CONDENSER: Arranged to operate in any position.

DECANTER: Stainless steel. Sight glass.
INSULATION JACKET: Arranged to protect main body of vessel as well as to service electric heaters.



10 GALLON LAB AUTOCLAVE

Vertical design with removable top cover, stainless steel internal surfaces.

AUTOCIAVE: Designed for full vacuum pressure.

JACKET: Designed for 100 lb. pressure. AGITATOR: Speed of 34-138 rpm. p-k Agitator 15" diameter.



Want a question? complete specifications . . . ? We'll be happy to send you more information on these and other units in p-&'s wide line of research, development and production equipment for the processing industries. Send us your question, specific or general.



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101 Park Avenue, New York 17 . Railway Exchange Building, Chicago 4 . 1700 Walnut Street, Philadelphia 3 . 96-A Huntington Avenue, Boston 16 . and other principal cities.

Continuous Vacuum Filtration Formerly Requiring

OLIVER UNITED

CAKE DISCHARGE

...for those

OLIVER PRECOAT FILTER

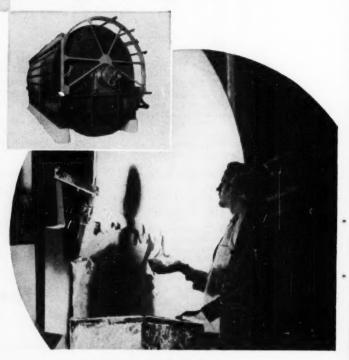
with its continuous discharge of a thin cake formed over a thick, pre-formed cake of a porous material such as diatomaceous earth. The cake is shaved off continuously, usually with a thin film of precoat, by a traveling knife edge that moves slowly inward toward the drum under controlled speed. Thus, a fresh clean surface of filter aid is always present for cake deposition as each section of the drum rotates through the slurry in the filter tank. Precoating takes an hour or two; the filtering cycle runs from 8 hours to several days depending upon the amount of precoat removed.

Sizes of Oliver Precoat Filters range up to 540 square feet of filter area (open type); up to 200 square feet (hooded & vapor type) and up to 165 square feet (continuous pressure).

OLIVER PANEL FILTER

with its continuous discharge of thin sticky cake from the drum, usually by means of two crossed taut wires stretching from one end of the drum to the other in contact with the inflated filter cloth. These wires lift the cake from the drum very cleanly . . . a cake that would tend to pack in between the wire winding of the conventional wire wound drum type filter. An optional method is a small diameter couch roll. In the Panel Filters, no wire winding is required. The cloth is put on in bolt widths, each large enough for one to three drum sections and caulked in between the division strips. One of the useful features of the Oliver Panel Filter is that it can readily be converted to the wire wound deck type should later changes in production alter the nature of the cake in such a way as to make the wire wound filter better for the new operations.

Sizes of the Oliver Panel Filter range up to 790 square feet of filter area.



for Slurries Pressure Filtration

offers 3 DIFFERENT METHODS

'Difficult-to-Handle' filter cakes

OLIVER STRING FILTER

With this type, a series of endless strings travel circumferentially around the filter drum about $\frac{1}{4}$ " apart and on top of the filter cloth. The cake is formed on top of these strings in the normal filtration stages of the filter drum rotation.

At the discharge point in the filter cycle, the strings lead the cake off the drum around a small diameter roll where the cake is dislodged and the strings travel back into the filter tank and around the drum again to repeat the operation.

Sizes of the Oliver String Filter range up to 790 square feet of filter area.

WE have nothing against pressure filtration. In fact, we have several different types of pressure filters, including such well known units as the Sweetland, Kelly and Oliver Pressure Filters. And we are selling them right along for slurries that just can't be handled in any way by the continuous vacuum method.

BUT, there's no denying the fact that continuous vacuum filtration is the more desirable method. It's faster, cleaner and usually more economical. Washing is under better control. When there is sufficient tonnage to warrant, continuous operations with steady flow rates and uniform cake are certainly to be preferred over batch operations.

The character and quantity of solids plus their processing destination usually determine the choice of filter. Most products produce cakes easily handled on the standard drum type filter, the Oliver Continuous Filter. Others — and this is the kind we have in mind — just cannot be handled on such a filter. Either, the per-

centage of solids is so low or the cake-forming solids are so slimy or sticky or otherwise impervious as to preclude the formation of a sufficiently thick, dischargeable cake.

For such cake-producing solutions and slurries we can offer continuous vacuum filtration with three distinct types of filters from which to select. These are illustrated and described on the opposite page and above. Note the differences in methods of cake discharge.

If you are carrying on batch filtration or have a new product that produces a 'difficult-to-handle' cake, why not let our engineers tackle the problem of (1) determining if continuous vacuum filtration is feasible and (2) what type of cake discharge would be best?

In working with you on this, we would be bringing to your problem more than forty-five years of filtration experience in every major industry all over the world and covering countless problems of widely varying character.

WORLD WIDE SALES, SERVICE AND MANUFACTURING FACILITIES

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• Cable — OLIUNIFILT



CHEMICAL ENGINEERING—December 1954

size and polarity, preferentially adsorbing small molecules over large, unsaturates over saturates, polar over nonpolar, straight chains over branched.

To accomplish this feat, Linde starts by making synthetic zeolites (sodium or calcium aluminum silicates), then heating to drive off water of crystallization. This leaves many small, uniform-size cavities, interconnected by still smaller pores which are also uniform in size.

The empty spaces, totaling 50% of the total space, has a very strong tendency to recapture its lost water. If no water is present, though, it will accept any molecule that's smaller than the pores. By varying pore size, therefore, you can effect a wide variety of separations.

So far, two types are available from pilot plant production, 4A and 5A, which have pore openings of about 4 and 5 angstroms, respectively. Each is available in three forms—powder, \(\frac{1}{6}\)-in. and \(\frac{1}{16}\)-in.

pellets-all priced at \$1.95 a pound.

Typical compounds adsorbed on 4A are water, CO₂, ethane, propylene, acetylene and *n*-propanol. From any of these you could separate such products as propane and higher *n*-paraffins, higher *n*-alcohols and higher *n*-olefins, all of which are adsorbed by 5A, but not 4A. Molecules larger than 5 angstroms, which of course are not adsorbed by either type, include all aromatics, branched chain paraffins and branched chain alcohols, plus cyclic compounds with more than three-membered rings.

You can use Molecular Sieves under a wide range of operating conditions, too, because adsorptive capacity is high at both low concentrations and high temperatures. Type 4A, for instance, will take up 19% of its weight of water from a gas that

has a relative humidity of only 2%.

Finally, reactivation is simple, usually consisting of just heating and purging. (The material is stable even at red heat.) Thus adsorbed products can be recovered easily for reuse.

Smog so bad, refineries implored to close

During a particularly serious smog siege in Los Angeles recently, California's Gov. Knight, hard-pressed by public cries to do "something," appealed to the area's oil refiners to cease operations. The idea was to test oil's contribution to air pollution, but in industry's opinion, it was mostly straw-clutching motivated to a large extent by politics.

To no one's real surprise, the refineries flatly refused to close. Backed by recent smog studies that put more than 80% of the blame on automobile exhaust fumes and back-yard incineration,

refiners maintained nothing could be proved by a shutdown. They also were quick to point out that one of the city's worst smog sessions—in 1948—coincided with a general refinery strike that closed all but one major refinery in Los Angeles.

Nitrogen fixation process enters new phase

Food Machinery and Chemical Corp. will continue pilot plant work on nitrogen fixation. Contract with Army Ordnance and Wisconsin Alumni Research Foundation for building and operating a demonstration unit at Kansas City has been terminated because present process is not economical. But Food Machinery hopes to correct certain technological difficulties and get it on a paying basis.

The Wisconsin process uses a high temperature pebble heat exchange furnace to make dilute nitric oxide. Substantial tonnages of high grade nitric acid were produced during the original operating period and the structures proved able to

take continuous operation at 4,000 F.

New primary source for lithium chemicals

One of the largest, and probably the highestgrade, lithium deposits in the world-located in Southern Rhodesia-will be the sole ore supply for a big new lithium hydroxide plant being built by C. F. Braun for American Potash & Chemicals near San Antonio, Tex.

Until recently this ore, called lepidolite, was very scarce and was used mainly as a direct additive in such products as glass. But now American Potash, with ample supplies available, has developed a direct limestone roasting process for making lithium hydroxide from this new source.

Foote Mineral, which is again expanding its Sunbright, Va., lithium hydroxide plant, also uses limestone roasting, but on spodumene. Previous work with lepidolite, mostly in Europe, has been on a small scale with acid or potassium sulfate processes that necessitate separation of product from alums.

The new Texas plant will actually be owned by a newly-formed company, American Lithium Chemicals, 50.1% owned by American Potash, the rest by Bikita Minerals, Ltd. American Potash also owns 21½% of Bikita (Selection Trust, Ltd., of London controls 50% and American Metals Co. is the other principal stockholder). Total capital requirements of American Lithium and the Bikita property will be over \$8 million.

(Continued on page 110)

Creating New and Better Basic Chemicals for American Industry



General Chemical Research Laboratory located adjacent to Allied Chemical's Central Research Laboratory in Morris Township, New Jersey

This is General Chemical's new Research Laboratory in Morris Township, New Jersey. Here, General will expand and intensify its diversified research in industrial, scientific and agricultural chemical fields.

A highly important phase of the Laboratory's activities is studying ways to make good products better, more abundant and more economical. This includes continuous product and process developments with sulfuric acid and other basic chemicals, as well as with General's extensive lines of reagents and fine chemicals, and agricultural insecticides and herbicides.

"Genetron" Organic Fluorine compounds—already widely being used in refrigeration, air conditioning, and aerosols—typify the new products for modern living coming out of the Laboratory's current investigations. Many others will follow as today's experiments become commercial realities.

The research here forms the foundation for large-scale development programs at other General Chemical laboratories near Philadelphia and Baton Rouge, La. It is also closely coordinated with related phases of Allied Chemical's central research program . . . all aimed toward creating new and better chemicals for American Industry—and you!



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Alums
Genetrons® and other fluorine derivatives
Phosphates
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But all is not rosy. American Potash is being sued by American Metals (part-owner of Bikita) for alleged violations of 1953 contracts that called for joint efforts in the lithium chemicals field.

American Metals claims it has been completely disregarded in this present venture and wants full information on the work to date and the right to buy half of American Potash's stock in American Lithium. American Potash's reply is that the agreement didn't cover the Bikita project and that American Metals is therefore not entitled to a share in American Lithium.

One thing's certain, though. No matter who wins the court fight, utilization of these new African ore deposits is an important step toward assuring good supply of needed lithium chemicals.

Oil new flowing from Iran

The long Iranian oil dispute, which stopped production there in 1951, is officially over. Shortly after the Shah signed an export pact concluded with the eight-company operating consortium, the first oil was pumped to a waiting British tanker and operations were resumed at the huge Abadan refinery formerly owned by Anglo-Iranian Oil Co.

Most terms of the pact were revealed some time ago (Chementator, June 1954 and Oct. 1954). One new fact, though, is that Anglo-Iranian, which has a 40% interest in the consortium,* will get over \$670 million in compensation—\$70 million from Iran, \$91 million from consortium partners and \$510 million in royalties from oil exported by the other firms.

Magnesium plant sale still wide open

Until Jan. 31, 1955, anyway, Dow Chemical will continue to operate the government-owned magnesium plant at Velasco, Tex., although at a reduced rate. After that, who knows!

Here's the situation: Dow's lease to operate the facilities ran out Oct. 31. Although it had an option to renew, Dow wants to buy the unit outright, offered about \$13.5 million—\$9 million cash, plus a percentage of future production. Both the General Services Administration and the Defense Dept. okayed the idea, but the Justice Dept. said no because the sale "would tend to maintain a situation inconsistent with the antitrust laws."

The Justice Dept. suggested that GSA try to sell the plant to someone else, but so far there have

been no takers. As a stop-gap measure, Dow agreed to continue operating until Jan. 31 at about 75% of the rated capacity of 44,000 tons a year. Meanwhile, GSA will keep trying to effect a sale.

But the chances don't look good. Expected U. S. demand is only 48,000 tons next year and 55,000 tons in 1956. And Dow can make 36,000 tons annually at its Freeport, Tex., plant. That doesn't leave much for any new company in the field, particularly in view of Dow's already solid market.

The government has good reason for wanting to keep the plant running. If no acceptable buyer is found, and Dow decides not to continue on a lease basis, it will have to be mothballed. That would cost about \$3.5 million initially, plus \$1 million annually for maintenance. Even then, some experts believe the corrosive atmosphere surrounding the installation would make it valueless in ten years.

U. S. dye makers raise their guard

Shedding for the moment their traditional cloak of secrecy, just about all the nation's 60-odd manufacturers of coal tar dyes and colors have consented to send to the U. S. Customs Bureau complete chemical and physical data and samples of their products. The reason: to protect themselves as much as possible from foreign competition.

The move was precipitated by new Customs regulations on importation of coal-tar products into the U. S. All foreign exporters are now required to detail—with their invoices—all product specifications other than actual molecular structure. In addition, the Customs laboratory in New York will set up an official file of samples of domestic products that can be compared with imports to determine whether a competitive situation exists.

This is vitally important. Under the Tariff Act of 1930, which Customs says is unworkable in its present state, coal-tar imports that compete with domestic products are assessed for duty at the American selling price. Noncompetitive items are nearly always assessed on a much lower selling price basis.

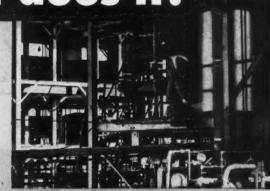
U. S. producers of these chemicals have long been encouraged to submit samples and data to Customs. But it's been a haphazard arrangement. Now with one central file it's expected that processing of coal-tar chemicals through Customs will be faster with less chance of misclassification that could hurt American manufacturers.

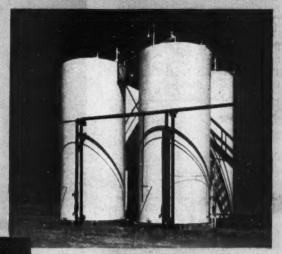
For more of WHAT'S HAPPENING.....112

^{*}Others are Guif Oil, Socony-Vacuum, Standard Oil (N. J.), Standard Oil (Calif.) and Texas Co., &% each; Shell, 14%; Compagnie Francaise des Petroles, &%.

EPON RESIN does it!

New paint
lasts years
...resists
corrosive spillage
at
Diamond Alkali
plant





HERE'S HOW...

Paint Leads a hard life at the Diamond Alkali Company agricultural chemicals plant in Houston, Texas...and no ordinary paint can survive there for long!

A few reasons for paint failure: Processing vessels and storage tanks are subjected to spillage of chlorinated hydrocarbons and benzene, and some also to heat. In parts of the plant, painted surfaces are exposed to the highly corrosive fumes of hydrogen chloride and sulfuric acid.

In their search to find a tougher, longer lasting paint, Diamond Alkali maintenance men tried coatings of many types, including heavy duty maintenance finishes. Some "washed off" immediately; some lasted 6 to 8 months. Finally, Epon resin coatings based on the XA-200 formulation were tried—and found outstandingly successful.

The Epon cold-cured paint, applied by spraying throughout the entire plant, has been in service for more than two years with no failure. Painting costs — for both material and labor—are a mere fraction of what they formerly were, reports Diamond Alkali.

Call on our sales offices for names of suppliers who sell Epon resin coatings for your needs. Write for the full Epon coatings story in the new brochure, "Planning to Paint a Pyramid?"



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DECEMBER 1954

What's Happening

Feature News This Month

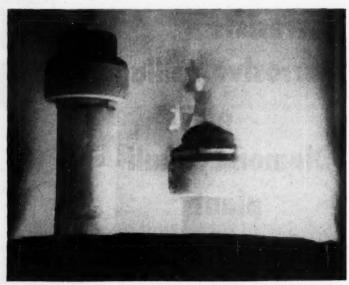
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Two Polyphosphate Plants 132
Plant Planning by Models

New Cell Makes Cheaper Fluorine

Engineers of Union Carbide & Carbon Corp. have developed a "medium-temperature electrolytic fluorine cell" that is said to make fluorine (essential in producing U-235) at lower cost, in less time and at a higher rate. It has doubled the life of previously available cells.

Innovations are numerous. A stress-relieved nickel-base alloy is used for the inner shell. Changing the cell size and using fewer but wider anodes has increased effective anode area by 30%. Polarization has been minimized by using an electrolyte with less than 0.1% impurities, hydrogen fluoride with less than 0.1% moisture, an electrolyte preconditioned with fluorine, and by careful anode selection.

Normal working conditions are 8-10 v. and 3,500-4,000 amp., with a current efficiency of 90%. Electrolyte temperature is kept between 200 and 220 F. In the future, Carbide sees this cell as being adaptable for use in industrial processes generally, operating in multi-cell banks.



ARC FURNACE makes Zr carbonitride for chlorinating and hafnium removal.

On the Way: More Zirconium

Announcements of plans for nuclear reactors are coming thick and fast. And as both the government and private industry step up the pace of reactor construction, suppliers of the materials which go into nuclear reactors are boosting their output.

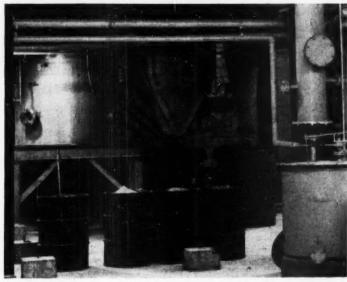
One such material is zirconium, essential in the construction of reactors. After more than a year of valuable experience in large-scale production of hafnium-free zirconium, Carborundum Metals Co. is now ready to increase output from its Akron, N. Y., plant

to keep pace with the surging demand.

Today the company is producing pure zirconium sponge at a rate of 150,000 lb. per yr. and selling it all to the Atomic Energy Commission for "less than \$15 per lb." The commission also takes Carborundum's entire output of pure hafnium—about 3,000 lb. per yr. —which it separates from zirconium in the process.

► Why Zirconium—Were it not for the nuclear energy program zirconium would probably be just another element on the periodic

in Chemical Engineering



CHLORINATOR converts Hf-free ZrO2 to ZrCl, for magnesium reduction.

for Nuclear Reactors

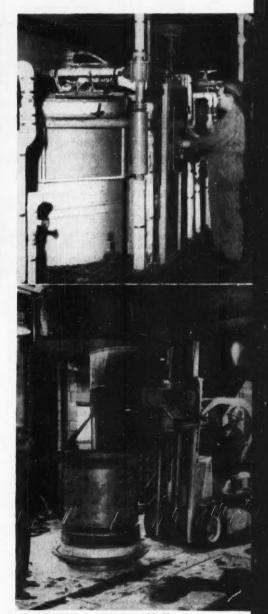
table-one with attractive properties, but too difficult to purify for widespread commercial use. But to the AEC zirconium had one property which was just too tempting to pass up. It allows neutrons to pass through it, doesn't absorb them.

Combined with other favorable properties - high melting point, great strength at high temperatures and outstanding corrosion resistance-this ability to pass neutrons makes pure zirconium an ideal structural material for atomic reactors. But there's a major ob-

conium always contains about 21% of its weight in hafnium. And hafnium so readily absorbs neutrons (hafnium can be used for neutron-absorbing control rods in atomic piles) that reactor-grade zirconium must be as low as possible in Hf content.

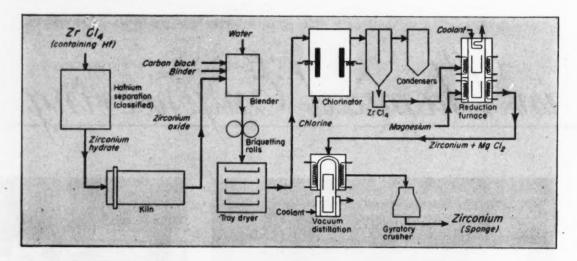
commercially is knotty problem, since both zirconium and hafnium

^{*}Zirconium is the ninth most abundant metal in the earth's crust. It is present in greater quantities than such familiar metals as nickel, copper, zine, lead, tin and mercury.



REDUCTION FURNACE yields Zr sponge.

stacle-as it occurs in nature* zir-Separating the two elements



have similar physical and chemical properties. Of the several available methods of separating the materials, the one selected by the AEC and used by Carborundum Metals is still classified.

▶ How It's Made — Carborundum Metals, a wholly owned subsidiary of the Carborundum Co., starts with hafnium-containing zirconium tetrachloride.* If commercial metalt is to be made, the tetrachloride goes directly to the reduction furnace. To make low-hafnium zirconium for reactor use, the tetrachloride passes through the separation process first.

Zirconium emerges from the hafnium separation process as the wet, hydrated oxide, which is dried and calcined in a gas-fired, rotary kiln at 1,650 F. The shell (3 ft. dia. and 25 ft. long) is built of Type 309 stainless steel, insulated on the outside by 4 in. of Carbo-frax brick and surrounded by sheet aluminum.

The kiln revolves once in 16 min., and is designed so that gas velocity through it is held to 2 ft. per sec. Oxide leaves at about 1,000 F.

Dry oxide is mixed with carbon black, an organic binder (e.g., sugar) and water and briquetted on a roll-type briquetting machine. The briquettes resemble small eggs—about 1½ in. long. They go to a tray dryer where they are dried at 250 F.

► Chlorinating the Oxide—Dried briquettes are chlorinated in a steel vessel about 12 ft. high and 5 ft. in diameter. It is lined with silica insulating brick and silica refractory brick. Three graphite electrodes project into the vessel about halfway up the sides and 120° apart.

Chlorination of the oxide (described in Chem. Eng., Sept. 1953, p. 158) is an endothermic reaction. The charge of briquettes serves as an electrical resistor; heat generated by passing three-phase current through it maintains the reaction. Voltage is low, only about 50 v. maximum, but a current of several thousand amperes is used.

Heated chlorine gas enters the chlorinator at the bottom. ZrCl, vapor passing out near the top crystallizes at 600 F. in a stainless steel condenser immediately alongside the chlorinator. A cyclone-type aftercooler competes the condensation.

Crystals drop out of the condenser and aftercooler into stainless steel drums for charging to the reduction furnaces.

▶ Reducing Yields the Metal — Molten magnesium reduces the pure tetrachloride to sponge metal.

As shown in the picture on p. 113, an electric furnace is loaded with two drums, one above the other. The upper holds the ZrCl, crystals and the lower one (Inconel) contains bars of magnesium. The stacked drums, separated by a spacer, are raised into the furnace by a hydraulic lift.

The bottom of the furnace is sealed off and the air displaced by argon. Heat from electric coils vaporizes the ZrCl₄ and melts the magnesium. The vapor finds its way to the surface of the molten magnesium, where it reacts to form metallic zirconium and MgCl₄. The zirconium settles to the bottom of the drum and the MgCl₄ floats above it.

Temperature in the furnace reaches 1,800 F. during the reaction and the pressure is held to 1 psig. The reaction is controlled by having separate heating zones around each of the drums, and by running cooling water, if necessary, through a stainless coil at the top of the furnace to condense ZrCl, vapor.

This operation also purifies, since metallic impurities picked up during chlorination have a lower volatility than the ZrCl₄ and so remain in the upper drum.

▶ Purified by Distilling—The zirconium-containing drum is taken from the furnace, the bulk of the MgCl₁ is chipped out and the drum goes to a vacuum still. The drum

^{*}The tetrachloride is made by reacting sircon with carbon and nitrogen in an electric arc furnace and literally burning the resulting carbonitride in a chlorine atmosphere.

[†]Commercial sponge sells for about \$10 per lb.

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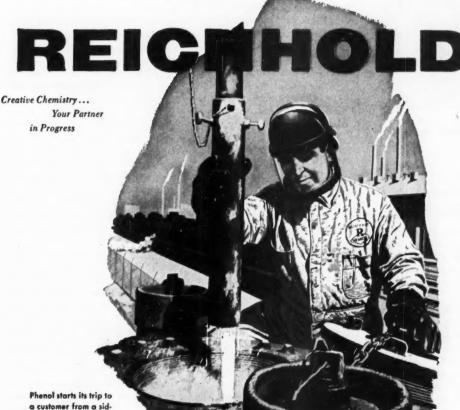
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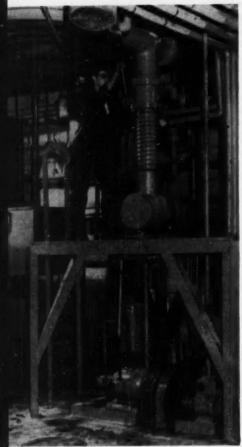
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ing at RCI's Tuscaloosa plant where it is being loaded into a tank car.



VACUUM DISTILLATION removes MgCl, from the sponge metal.

is placed in the upper part of the still in an inverted position, and a drum to receive and condense the MgCl₂ is placed in the lower end.

An electric heater fits snugly over the top of the still and heats the upper portion to 1,650 F. Cooling water passes around the lower end of the chamber to condense vapors.

Pressure in the still is held to between 10 and 20 microns by an oil diffusion pump backed by a mechanical vacuum pump. To reduce the pressure differential on the steel shell of the still, the space between heater and still is evacuated to a pressure of 1 mm. Hg. This permits the use of a thinner wall cross-section at these high temperatures.

▶ Finishing Operations—When the

temperature in the still suddenly increases and the pressure suddenly drops, distillation is considered complete and heating is stopped. Cooling results in shrinkage of the sponge metal in the drum and simplifies removal. The sponge is then broken up on a drill press.

Chunks of sponge go to a gyratory crusher where they are ground to pass a 1-in. screen. Fines are also separated since they are usually high in impurities.

Carborundum Metals then packages the zirconium in dust-tight containers for shipment. Each batch is subjected to extensive quality control tests to insure proper purity. Production of pure hafnium follows the same general process as zirconium.

Chloro-Methane Plant Started Up by Solvay

In addition to chlorine and caustic soda, Solvay Process Div. of Allied Chemical & Dye Corp. is now turning out chloro-methane compounds at Moundsville, W. Va. A new plant there produces methyl chloride, methylene chloride, chloroform and carbon tetrachloride, all new to Solvay's product line. By-product muriatic acid and anhydrous hydrogen chloride are also made now at Moundsville.

Polyurethanes to Get Two-Pronged Boost

Construction has begun on two new plants for the manufacture of isocyanate chemicals. These products, together with polyester resins, are the raw materials for polyurcthane rubbers, which in tensile strength and load-bearing capacity are reported to be much superior to GR-S rubber.

First to start up will be facilities now being built at Buffalo, N. Y., by National Aniline Div. of Allied Chemical & Dye—probably in the first quarter of 1955. Output will include various tolylene diisocyanates and diphenylmethane diisocyanate.

A little further behind, Mobay

Chemical Co. (joint enterprise of Monsanto Chemical Co. and Farbenfabriken Bayer, A. G.) will build a full-scale plant at New Martinsville, W. Va. It will produce several hundred tons of isocyanates monthly. Operations are expected to begin next fall.

Chemical Lights On the Dark Continent

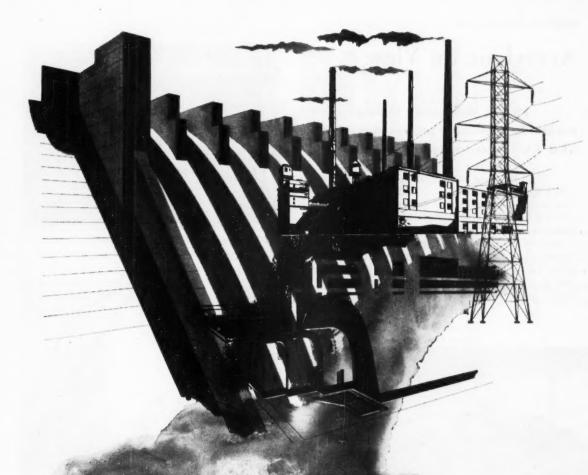
Although a latecomer to the industrial revolution, the South African chemical industry is definitely on the rise. Latest forecasts indicate it will require an annual capital investment of \$7.5-8 million over the next 10 years. About half this amount will go into established industries, the rest to new enterprises.

Right now, three big projects are nearing completion.

Best known is the \$85 million Sasol oil-from-coal plant which will produce both petroleum and basic chemicals, such as benzene and ethanol. Company policy will be to supply products at, or slightly below the import prices. Parts of the plant are now operating, the rest will be next year.

Also scheduled to make basic chemicals is a \$5.6 million chlorine-caustic plant being built near Durban by African Explosives and Chemical Industries, Ltd. The company, which is half-owned by Imperial Chemical Industries of England, will also make chlorine-based solvents and polyvinyl chloride. Full production is expected late next year.

On the textile front, one of the world's largest rayon pulp mills will start up near Durban in 1955. It is a \$22.4 million undertaking and will produce 40,000 tons of pulp vearly. Half will be exported to Italy, half to Great Britain. There are three partners in the venture: Coutaulds, Inc., of Britain, Snia Viscossa of Italy, and South Africa's Industrial Development Corp., a government agency that launches major industrial projects and then gradually relinquishes its holdings to private firms as the profit stage is reached.



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Acetylene on View

Photos, flown from Ludwigshafen too late for November process story, show what BASF acetylene plant looks like.

We thought you'd like to see these pictures. They show some of the key process points in the Badische-Anilin & Soda Fabrik partial oxidation of methane to acetylene (see Chem. Eng., Nov. 1954, p. 116).

Specially designed burners convert methane and

oxygen to off-gas with 8.5% acetylene. Three soot filters (larger towers at right) collect any carbon formed. Gas is sent to compressors, coolers, the concentration system and storage.



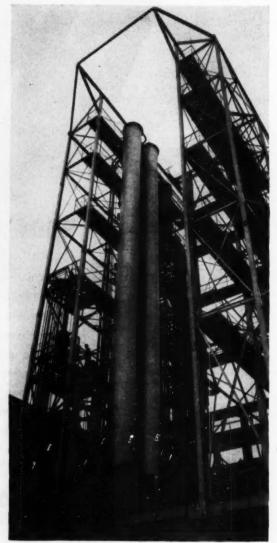
BURNERS and soot filters to remove carbon.



COMPRESSORS reduce volume handled by . . .



COOLERS and the three-tower . . .



CONCENTRATION system.

how **BIG** should a dryer be?

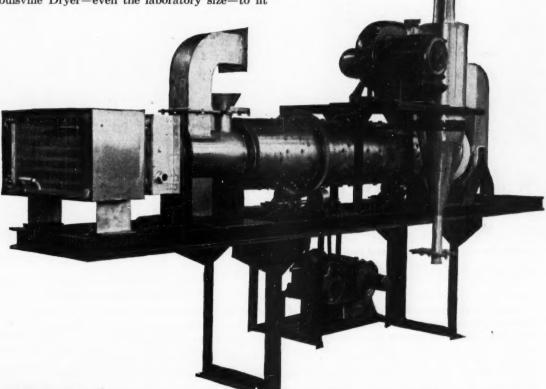
"Baby" Louisville Dryers do a man-sized production job for chemical firm

A large chemical firm has twice bought small, laboratory-size Louisville Dryers to serve as pilot plants for new materials. In both cases, their engineers were amazed to find the pilot dryers were producing sufficient quantities to supply the market!

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the job, and to give years of satisfactory performance at rock-bottom maintenance cost.

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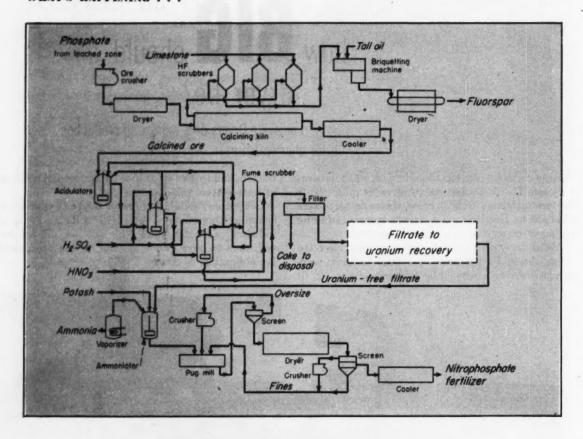
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Waste Ore May Yield More Uranium

Production of nitrophosphate fertilizer from leached-zone ore now wasted could multiply the amount of uranium recoverable from Florida phosphate deposits.

Atomic Energy Commission's efforts to get maximum uranium yield from Florida's phosphate resources may accomplish more towards establishing a nitrophosphate fertilizer industry in the U. S. than did the little-lamented sulfur shortage of 1951-52.

These efforts are aimed at finding profitable uses for the phosphate-containing overburden now wasted in present mining operations in Florida. This material, known as "leached-zone" ore, overlies the currently used high-grade phosphate rock "matrix" in beds 2 to 25 ft. thick. It contains 10 to 12% P₂O₅, compared with 30 to 35% in the pebble concentrate derived from commercial matrix.

According to a \$50,000 engineering and economic study recently made by Blaw-Knox's Chemical Plants Div. for AEC,* a plant could make 200,000 tons of nitrophosphate fertilizer (15-15-15 analysis) at a manufacturing cost of about \$54 per ton. For a 20% return on investment (before taxes) the product must sell for about \$81 per ton.

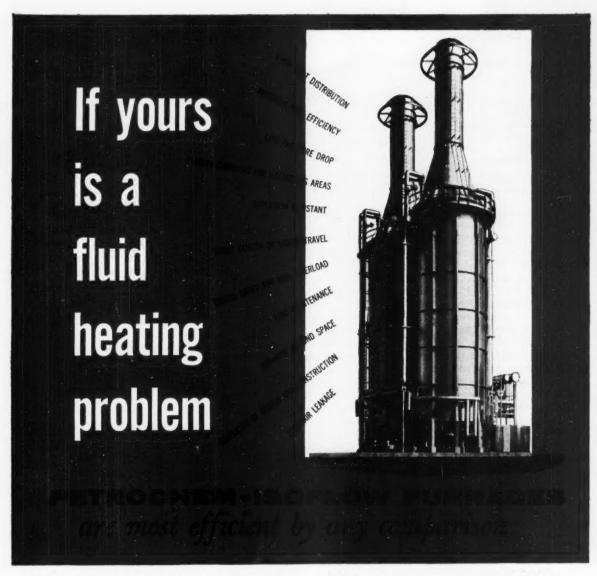
Investment for a completely integrated operation is estimated at \$27 million, excluding contractor's overhead and fee.

▶ Byproduct Uranium—Both matrix and leached-zone ores contain only minor concentrations of uranium—0.1 to 0.4 lb. U₃O₀ per ton. However, the tonnages mined each year make these materials huge potential sources of uranium.

In 1952, for example, more than 25 million tons of raw matrix was mined in Florida. Along with this, 14 millions tons of leached-zone ore was removed and discarded. This 39 million tons, even at the lower limit of concentration, contained about 4 million lb. of U₈O₈.

Four uranium recovery plants are already operating in connection with phosphate fertilizer and feed production from Florida matrix.

^{*} Blaw-Knox's detailed report is available to any member of the phosphate or chemical industry who has reason to review and evaluate the process.



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4. With a radiant loss of under 2% more heat is absorbed by the fluid being heated. This results in higher efficiency for any type of Iso-Flow design. 5. Since Petro-Chem designs include a wide variety of convection sections all heaters can be engineered for optimum fuel efficiency or for maximum fuel efficiency where the price of fuel and other economic considerations justify.

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How Blaw-Knox Figures Nitrophosphate Costs

Investment \$7,811,000	Manufacturing Cost per Ton \$49.96	20% Return Before Taxes \$88.80
2,446,000	32,111.2	38.61
1,077,000	17.871	25.05
4,174,000	4.36	7.72
11,492,000	69.801	81.29
	\$7,811,000 2,446,000 1,077,000 4,174,000	Investment Cost per Ton \$7,811,000 \$49.96 2,446,000 32.111.2 1,077,000 17.871 4,174,000 4.36

The phosphate operations are economically self supporting; cost of uranium recovery, allowing a modest profit to the plant operators, is comparable to that based on other sources of uranium.

AEC would like to see commercial phosphate operations established on leached-zone ore; this would appreciably increase the recoverable reserves of uranium. Manufacture of nitrophosphate fertilizer seems to be one of the best

▶ Nitric Acidulation-During the temporary sulfur shortage of three to four years ago, a number of fertilizer people seriously considered replacing with nitric acid part or all of the sulfuric acid normally used in acidulating phosphate rock to make superphosphate. Tennessee Valley Authority studied several process schemes, some based on European practice, others of its own invention.

At least eight companies projected nitrophosphate plants, but only two have reached production -Allied Chemical & Dye Corp. at South Point, O., and Associated Cooperatives at Sheffield, Ala. A better sulfur supply picture has no doubt influenced some of the other firms to shelve their plans.

TVA went ahead with its process studies, however, turning its attention to nitric acidulation of leachedzone ore. Blaw-Knox has drawn freely on TVA's pilot-plant experience in its engineering study.

▶ Integrated Plant-Production of 200,000 tons per yr. of 15-15-15 nitrophosphate fertilizer (or 150,-000 tons of 20-20-0) would use 140 tons per day of anhydrous ammonia, 250 tons of 100% nitric acid (as 60%), and 100 tons of 100% sulfuric acid (as 66 Be.).

Blaw-Knox visualizes an integrated plant, with estimated investment and manufacturing costs as shown in the table and major operations as shown in the flowsheet. As byproducts, the plant would produce, in addition to a uranium concentrate, approximately 20 tons per day of synthetic fluorspar.

► Alumina Extraction?—Al₂O₃ content of leached-zone ore is of the same order of magnitude as P2O3 content. Aluminum Co. of America is spending a lot of its own money studying the possibility of extracting alumina from this material. Such an operation might precede the nitrophosphate process or might be entirely independent of it. (According to Blaw-Knox's material balance, about three-fifths of the alumina content of the ore rides along with P.O. in the product, the rest going into the waste filter cake.)

Additional research indicates the presence of substantial quantities of rare earths which can be extracted with the uranium. With the growing market for rare earths, this may well prove to be another byproduct for the phosphate industry.

Furnaces, Hydrogen, Sulfur: All by Girdler

Recently, at widely scattered locations, four different major chemical expansion projects were completed. Although seemingly unrelated, they did have one thing in common: All were designed and engineered, at least in part, by the Girdler Co., Louisville, Ky.

· At Pensacola, Fla., Newport Industries added a Girdler Hygirtol hydrogen manufacturing unit to its hydrogenation facilities. Hydrogen is made by catalytic steam-reforming of natural gas, then purified by two carbon dioxide removals and final methanation.

· At Yazoo City, Miss., Mississippi Chemical Corp., essentially finished expanding its ammonia plant from 120 tons to 290 tons a day. Girdler's role, in addition to building the basic plant, was the design and engineering of all additional synthesis gas generating and purification facilities. This includes two multi-tube reformer furnaces and a low pressure (10 psig.) methanation unit that replaces the original high pressure (1,000 atm.) step.

· At Aruba, Netherlands West Indies, Standard Oil Co. (N. J.) began operating a 40 ton per day sulfur recovery plant and a gas generator. Again Girdler did the design and engineering, including a

Girbitol unit.

· At Brea, Calif., Brea Chemicals' new ammonia plant includes two Girdler multi-tube reformer furnaces.

Thorium, Rare Earth **Process Developed**

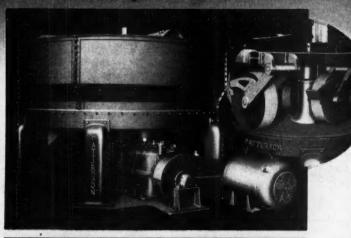
Monazite sand, already the world's best source of thorium and the rare earth metals, may soon become even more important because of a new, simpler recovery process developed at Battelle Memorial Institute, Columbus, Ohio.

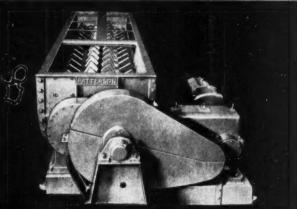
Chemically, monazite (found mostly in Brazil and India) is a mixture principally of phosphates of thorium and rare earths. It is upgraded by ore-dressing to concentrates, which are processed chemically.

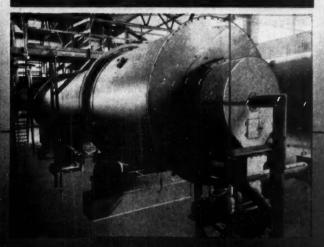
The conventional technique breaks down the sand by treatment first with sulfurie acid, then with water. The resulting solution, however, contains nearly all the phosphates in the sand, which seriously complicates recovery of the metals.

Battelle's process (still in pilotplant stage) gets around this difficulty by treating the sand with sodium hydroxide. This converts. metal phosphates to their hydrous

AGGLOMERATION --







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MULLING MIXERS

The Patterson Mulling Mixer is the primary unit for economical agglomerating. Equipped with wide-face mullers, it develops a highly effective kneading-smearing-wiping action. This unit is ideal for incorporating a small percentage of liquid in a large amount of dry material. As a plasticizing muller, it develops the working properties of the batch to fullest extent for subsequent forming.

TYPE GPM MIXERS PROCESSING PUG MILLS

Heavy duty, twin-shaft horizontal mixers of extremely rugged construction. The counter-rotating intermeshing pug mill blades assure thorough blending, and the slicing action assures chemical treatment of every part of the batch. Patterson Processing Pug Mills are used to blend phosphate rock fines with water preparatory to plasticizing, for treatment of phosphate rock with phosphoric acid in the manufacture of super-phosphate fertilizer. It is suitable also for processing many other materials.

PELLETIZERS

Retary type granulators and pelletizers, specially designed for thorough blanding and granulating—assuring a uniform homogeneous product by complete blanding of the searce and fine material, as well as thorough distribution of the binder, if used. Spherical, free-flowing granules or policies are produced, with a minimum of dust to separate in subsequent handling.

The Patterson Foundry and Machine Company

re vone Boston Baltimont, Pricastinan Privilagan person chemise misso et Louis Housson privil lat mastes san Pancisco, serte ho Pattarson Foundry and Machine Company, (Conada) Limite oxides and trisodium phosphate, which are separated. Next the oxides are dissolved in hydrochloric acid. Thorium is then precipitated by partial neutralization of the acid solution. Further neutralization precipitates a high-grade rare earth hydroxide product.

Carbide Definitely to Build Titanium Plant

Long-rumored entry of Union Carbide's Electrometallurgical Co. into titanium (Chem. Eng., Sept. 1953, p. 107) has now been confirmed. Plans call for production of at least 7,500 tons of titanium metal annually at a new \$31.5 million plant near Ashtabula, Ohio. Completion is expected in early 1956.

Besides its size-largest in the world-the new plant will be noted for the process employed. Instead of the usual Kroll method, Electromet will use sodium reduction of titanium tetrachloride. This technique has been in research and development at Niagara Falls, N. Y., for five years at a cost of nearly \$2 million.

Any titanium made that can't be sold to private industry will be bought by the government's General Services Administration for the first five years at prevailing market prices. This is protection against early process obsolescence.

Plastics May Benefit By New Alcohol Process

Citing both cost and quality advantages, Armour Research Foundation (at Ill. Inst. of Technology) is now touting its newly developed method of making furfuryl alcohol resin. Most likely to profit, says ARF, are the fields of plastic pipe,

chemical-resistant plastics generally and hot-melt coatings.

It works like this: A resin intermediate is formed quickly and smoothly by heating furfuryl alcohol in the presence of activated alumina, without using a strong acid catalyst as was formerly required. The liquid (or semi-liquid) intermediate can then be blended and cured to the final resin.

In conventional methods, a solvent (usually water) is added to moderate the reaction and the intermediate must be neutralized, washed and dried. All these steps are eliminated by the new process.

Besides lowered production costs, ARF says that the resin can be produced in a wide range of viscosities, in consistencies varying from semi-solids to grindable solids and with practically no monomeric furfuryl alcohol—a residue usually present in substantial quantities that causes unwanted shrinkage in the final resin.

Convention Calendar

The 21st National Exposition of Power and Mechanical Engineering, Commercial Museum, Philadelphia, Dec. 2.7

Instrument Society of America, Philadelphia Section symposium, "The Automatic Plant," Commercial Museum, Philadelphia, Dec. 3.

Society of the Plastics Industry, Fifth Film, Sheeting and Coated Fabrics Division conference, Hotel Commodore, New York, Dec. 7-8.

American Institute of Chemical Engineers, annual meeting, Statler Hotel, New York, Dec. 12-15.

Chemical Market Research Assn. and Commercial Chemical Development Assn., joint meeting, "Chemicals in Foods and Feeds," Edgewater Beach Hotel, Chicago, Jan. 20-21.

The 12th biennial International Heating and Ventilating Exposition, Commercial Museum and Convention Hall, Philadelphia, Jan. 24-28.

Chlorine Institute, annual meeting, The Biltmore, New York, Jan. 26.

Agricultural and Mechanical College of Texas (Texas A.&M.), symposium, "Instrumentation for the Process Industries," College Station, Tex., Jan. 26-28.



Cyanoethylation enters the pilot plant

Hoping to improve cotton's competitive position, and at the same time open a broad new market for acrylonitrile, the Institute of Textile Technology is now pilot planting a process known as cyanoethylation. The technique modifies cotton by reaction with acrylonitrile, leaving 3-5% nitrogen on the cellu-

lose polymer. Fabric is rendered rot and mildew proof, more heat stable and more readily dyed.

The plant, which was built by American Cyanamid at the Rossville, Ga., mill of Standard-Coosa-Thatcher Co., will turn out at least 20,000 lb. of treated material by mid-1955 for major field evaluation.



The Dragon that Bit Off its Tail

The ancient Chinese legend tells of Lin Fu, most powerful of all the dragons. Spewing smoke and flame, he lashed unscathed and victorious through combat after combat.

One day, his beady eyes spied a dragon's tail, and with a fuming, roaring rush, Lin Fu attacked. When the air had cleared he stretched in the sun to admire his own beautiful tail. To his horror, it was gone—and with it his strength.

Today, much of industry's strength is in its capital reserves. With little or no opportunity to acquire and perpetuate capital funds from plant operations under the present tax structure, a company's decisions must be based on assured profitable production—or bit by bit chew off its own tail.

Industry can ill afford mistakes of judgment-especially where capital investment in major equipment and process improvement is concerned.

Therefore, management's evaluation of major expenditures includes not only the expressed profits or savings from the investment, but the experience and integrity of the manufacturer of the equipment.

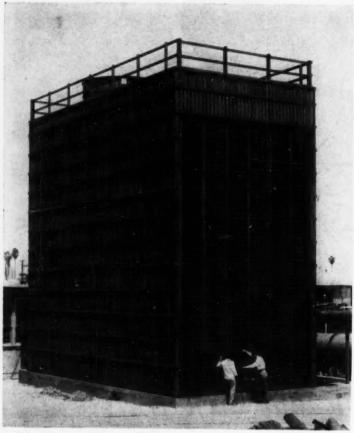
Hundreds of companies over the years have come to depend on The Sharples Corperation for sound, economical centrifugal equipment and well-engineered centrifugal processes—backed up by guaranteed performance.

The Sharple: Micromerograph provides rapid, accurate particle size distribution analyses of all types of powders—in simple graphic form. Bulletin 101 will be sent upon request,



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SEVENTH and largest in a series of experimental cooling towers will . . .

Help Get the Right Answers

Flexibility of operations, ease of scaling up test results—these advantages justify Fluor's big investment in cooling tower research on a large scale.

Newest addition to Fluor Corp.'s research facilities at Los Angeles is this \$30,000, 18 x 38 x 40-ft. experimental cooling tower.

With its tremendous capacity, the new unit will help Fluor engineers determine more accurately the optimum design and operating conditions for large, commercial towers. It fills the big gap between smaller test units and full-scale towers.

This is the seventh test installation in a cooling tower research program which Fluor began nearly ten years ago. Since then, Fluor has spent \$60,000 for equipment alone, many more thousands of dollars running the units and correlating the results. The present program requires the full time of five research and development men.

► Critical Problem — Rapid industrial growth of the past 15 years has emphasized the need for greater water conservation by cooling and reuse. Increasingly severe requirements for cooling tower design and

operation are characteristic of today's power, petroleum, chemical and steel industries.

As far back as the early '40's, Fluor Corp. decided that a new approach to cooling tower design was essential, that projections from small pilot towers or checks on commercial installations were inadequate. While pilot towers permitted test runs at various loads and with different packings, scale-up of results was not always reliable. And tests on commercial towers usually ran into limitations of narrow operating ranges or inability to interrupt normal operations.

► Fluor's Answer—Starting in 1945, Fluor began systematically to build up its cooling tower research and development facilities. Its first two units were built and operated at the University of Southern California.

The third unit, an 18 x 18 x 45-ft. tower with a 10-ft.-dia. fan, was built in 1950. Its water distributing system may be operated at any one of six elevations between 10 and 35 ft. above the basin. In 1953, Fluor added a 12 x 18 x 15-ft. unit adjacent to the 1950 tower.

Between them, these two units can handle various combinations of distributing systems, decking, fans and drift eliminators over a wide range of water and air rates. A 20-million Btu.-per-hr. tubular water heater provides the cooling load. While the towers operate independently, they are tied into the same heating, control and recording equipment.

Another recent installation is a plastic-sided tower. This one will test the properties of plastic panels under a wide range of operating conditions and determine the economics of plastic construction.

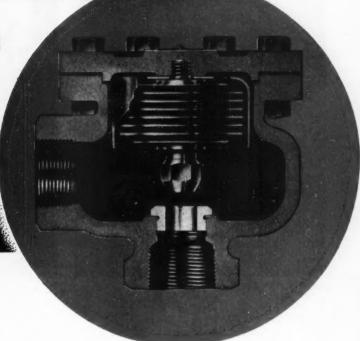
▶ Fan Design—Fluor has tested almost every type of fan made in United States and England. Considering the optimum balance between first cost and operating costs (including length of life and performance), Fluor concluded that it is cheaper to spend more money on the initial fan installation than had been standard practice.

NICHOLSON

Steam Traps feature

LESS parts

MORE capacity



Note the extreme simplicity of Nicholson industrial steam traps. The heavy-duty bellows integral with valve is the only moving part -- a substantial factor in their low maintenance cost. See also the larger valve orifice. This noteworthy feature results in Nicholson's 2 to 6 times average drainage capacity.

A recent survey showed the features following also to be reasons why plants with standardization-for-economy programs are increasingly adopting Nicholson traps: (1) Operate at lower temperature differential; fast action keeps equipment full of live steam; higher temperatures. (2) No air-binding; eliminate costly fluctuation of operating temperatures. (3) Freeze-proof; freely installed outdoors. (4) No need to change valves for varying operating pressures. (5) Record for low steam waste; as little as 1%.













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Bronze, semi-steel or cast steel construction. All 5 types have stainless steel valves and seats; bronze, monel or stainless steel bellows. Sizes, ¼" to 2"; pressures from vacuum to 250 lbs.

SEND FOR TRAP CATALOG 953

This 32-page standard reference is complete with installation diagrams as well as charts and formulae for determining proper size of trap. W. H.

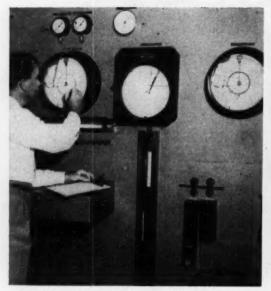
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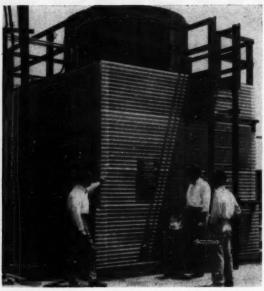
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INSTRUMENTS control tower conditions and record data. PLASTIC construction adds new dimension to the studies.



Fluor uses stainless steel, axialflow fans in all its towers. Most towers formerly had wooden or carbon steel fans. Often, in the early days, the fans were nothing more than surplus World War I airplane propellers.

Good tower design, according to Fluor, centers around the critical speed of the mechanical equipment, which can be averted by using three, four or five-bladed fans of different sizes. Mechanical failures in cooling towers used to be accepted as a matter of course, primarily because seldom had anyone analyzed the job the equipment was expected to do and designed accordingly.

▶ Drive Problems—In its studies Fluor found that the gear box and gears, exposed to moist air at the vent of the tower, are subject to extreme corrosion. Good design should pay attention to materials of construction for shafting, housing and bearings.

Along the same lines, corrosion is a big problem with motors, couplings and drive shafts. In addition, the size and style of mounting for the motor and drive shafts must be taken into account for optimum mechanical life of the tower.

► Drift Eliminators—In designing

drift eliminators, the big problem is to strike the right balance between pressure drop and moisture elimination from the air stream. A complex, well designed maze might remove all but trace amounts of moisture, vet give a pressure drop so great that the tower would be uneconomical to operate.

Also to be taken into account is the balance between first cost and operating cost and life expectancy. Using its test installations, Fluor feels it can come up with just about the optimum answer for any single installation by adjusting the number, width and positions of the slats.

▶ Packing — Most authorities consider packing the heart of the cooling tower. In fact, as much as 50% of the total amount of lumber used in the tower is there only to provide impact surfaces for breaking up water droplets.

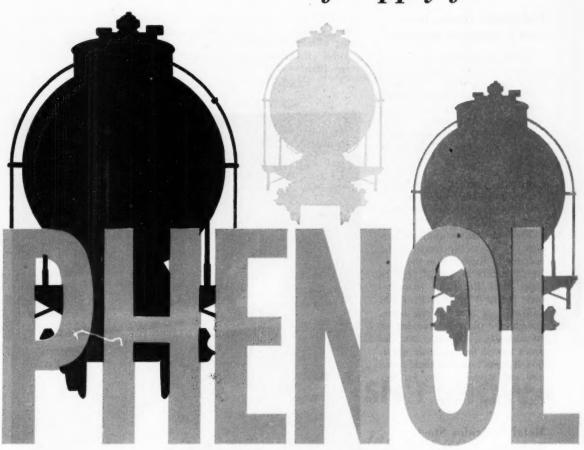
Yet with constantly changing relationships among available materials of construction, no one packing material can be considered universal. As the relative costs of various materials change, as new materials are developed and old ones reformulated, old concepts of packing must be re-evaluated. And at all times performance, pressure drop, fabrication and erection costs must be kept in mind. Add to this the virtually unlimited number of shapes and arrangements possible with any one material, and the empirical nature of cooling tower design becomes apparent.

But primarily as a result of its research and test program Fluor can design from a pure spray to a pure film with wood, ceramic or plastic packing. Until the price of plastic drops, however, wood will remain the biggest single tower packing material.

▶ Right Combination—In addition to studying each component in tower construction, Fluor engineers believe they have a pretty good idea of the interrelationships of these components. Increased knowledge is already paying off in better design standards and improved tower efficiencies.

With the current trend toward greater use of cooling towers in power plants, performance requirements often exceed those of conventional countercurrent or crossflow towers. Fluor thinks that a combination of countercurrent and crossflow-or even a more radical change-may be in order, expects its newest experimental tower to come up with the answer.

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Consider the advantages Oronite can offer you as a true basic source of supply for Phenol.

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You will find the quality of Oronite Phenol the highest (fully meeting the U.S.P. specifications) and priced competitively.

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Reichhold Opens Resin And Formaldehyde Units

Girding to meet the big demand increases expected in the field of resins and plastics, Reichhold Chemicals, Inc., has started up two new production units—for polyester resins and formaldehyde.

The polyester plant, which has a capacity of 10 million lb. a year, is at Azusa, Calif. It's characterized as embodying the most recent advances in production equipment. And it has been designed so that additional capacity can be added easily as needed.

The formaldehyde unit—at Charlotte, N. C.—is the fourth to be operated by Reichhold in the U.S. Its 25 million lb. annual capacity raises total Reichhold formaldehyde potential to more than 100 million lb. a year. In one sense, though, the plant is somewhat of an anomaly. Although it's the firm's newest formaldehyde operation, it doesn't use Reichhold's own new and unique process for this product (see Chem. Eng., Nov. 1954, p. 109).

Metal Hydrides Starts Reduction Service

If you'd like to be using a hydride reduction step in your process, but don't have the facilities or know-how, it may be worth your while to look over a new service offered by Metal Hydrides, Inc. On a contract basis, you can ship your own material to the firm's plant at Beverly, Mass., have the desired reduction carried out, and have the reduced material returned for further processing.

Speed and versatility of service are being emphasized. Few, if any, changes will be necessary in customers' over-all production schedules.

Hydrides, particularly those of alkali metals, have a broad field of application. Lithium aluminum hydride, for example, reduces many functional groups of organic molecules without danger of side reactions. Processes requiring fast reduction of acids, esters, ketones, aldehydes or acid chlorides, with or without hydrogenation of double bonds, often give higher yields using lithium aluminum hydride. Possible reduction temperatures range from -80 C. to 100 C., depending on the solvent used for the hydride.

All hydrides made by the company are also readily available for use in private plants.



CHARGE to new metals recovery system is big chunks of formerly wasted sludge.

Get Magnesium by Crushing

Dow Chemical at Freeport, Tex., has figured out a novel way to up its magnesium production by 2 million pounds a year without installing additional cell capacity. It's really a bonus, too, because this metal previously was lost as part of the waste sludge from the electrolysis step in Dow's main magnesium plant.

Sludge is primarily a mixture of fused and crystallized salts that traps small bits of magnesium metal and sinks to the floor of the cell. When removed it hardens into a solid cake containing as much as 10% magnesium.

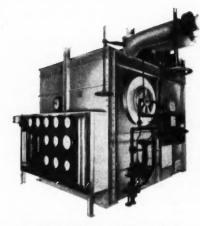
In the recovery, cakes of sludge weighing up to 100 lb. are dumped into a hopper (above) and drop into a jaw crusher. Crushed material is fed to a ball mill and then screened, fines going to a discard pile, coarse particles to a second ball mill. A second screening follows and the fines, mostly soluble chlorides, are washed away with sea water.

The coarse material, which by this time is essentially all magnesium, is accumulated and remelted into ingots. Because the material is hydroscopic, the entire system is closed.

	billion btu per		of —		DISTILLING FATTY ACID	
	mperature her rving the proc	-		OIL BODYING	MELTING SOLDERS AND OTHER LIKE METALS	
		/	MELTING ASPHALT	ACID CONCENTRATION PLANT	HITBILE PLANT	
		PLATING TIN	MANUFACTURING SYNTHETIC RESIN	HEATING CHEMICAL PROCESS EQUIPMENT	PROCESSING PAINTS AND VARNISHES	
	ESTERIFICATION	DEHYDRATING CASTOR OIL	PROCESSING FOOD PRODUCTS	MOLDING PLASTIC AND RUBBER PRODUCTS	CATALYST HEATING AND REGENERATION	
NITRILE	MANUFACTURING LINOLEUM	HEATING ROTATING DRUMS AND COAT- ING ROLL	CONCENTRATING SULFURIC ACID	FRACTIONATING FATTY ACID	DRYING AND BAKING ENAMELS	
DEODORIZING VEGETABLE OILS	EVAPORATING HIGH- BOILING MATERIALS	PETROLEUM FRACTIONATION	INDIRECT AIR HEATING	DISTILLING PHTHALIC ANHYDRIDE	ESTERIFICATION	

WHAT THIS CHART DOESN'T SHOW-

is the technical knowledge needed to design a heating system right



1933

izer, 4,000,000 btu/hr, 650F, 58 psig.

The important elements which cannot be shown graphically are the experience and vast technical knowledge which Foster Wheeler engineers have acquired in the design and construction of the specialized equipment needed to do the job right.

Yet it is this know-how that has achieved an unparalleled record of fine performance in nearly five hundred installations. The result of over twenty-one years' experience in the development of Dowtherm high-temperature, low-pressure process heating systems, Foster Wheeler know-how has produced some of the largest systems in operation today (up to 45,000,000 btu per hr at 700F and 88 psi) as well as the smallest (44,500 btu per hr at 700F and 88 psi).

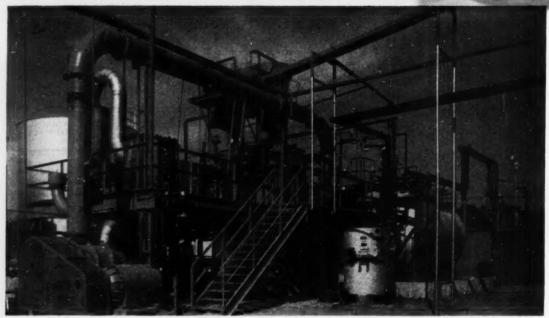
Foster Wheeler's specialized technical knowledge is your best assurance of the cost reduction and product improvement you are seeking as an economical solution to your critical processing problem. Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

FOSTER



WHEELER

1954



A NEW DESIGN-phosphorus combustion chamber at Virginia-Carolina's phosphoric acid-polyphosphate plant.

PHOSPHORIC-POLYPHOSPHATES:

More Than One Way to Solve a Problem

They both make phosphoric acid and sodium polyphosphates, but these two new plants embody important—and different—equipment designs.

A pair of new phosphoric acidsodium polyphosphate plants have just gone on stream in the Cincinnati-Louisville area.

At Fernald, Ohio, Virginia-Carolina Chemical Corp.'s new \$1-million plant is capable of turning out 36,000 tons per yr. of phosphoric acid. It's made from elemental phosphorus, shipped in from V-C's Nichols, Florida, or Charleston, S. C., electric furnaces.

Most of the acid is converted to sodium tripolyphosphate (Na₀P₅-O₅₀). For a description of the process see this month's pictured flowsheet, pp. 320-323.

At Jeffersonville, Ind., just across the Ohio river from Louisville, Ky., Shea Chemical can produce 80,000 tons per year of phosphoric acid. Elemental phosphorus comes from Shea's Columbia, Tenn., electric furnace. Most of the acid is converted to sodium tripolyphosphate, tetrasodium pyrophosphate and other phosphates. The remainder is purified to food-grade acid.

Sodium polyphosphates are important detergent builders (dispersing and sequestering agents) riding the coat-tails of the synthetic detergent boom. Shea and V-C have located the plants close to large detergent producing centers.

► Modern Design—Both use a basic three-step process: (1) oxidation of elemental phosphorus to phosphoric anhydride (P₂O₄), (2) hydration of the anhydride to 75-85% phosphoric acid, and (3) reaction of acid with soda ash and calcination to sodium tripolyphosphate, or pyrophosphate.

But Shea's and V-C's engineering groups have each come up with new and different answers to the disadvantages of conventional plant designs. Here are the new V-C designs:

• A vertical phosphorus combustion chamber, where extensive use has been made of stainless steel, replaces graphite. The design permits the use of pressure in the operation. A water-jacketed, stainless hydrator for making phosphoric acid replaces the conventional carbon construction. Raschig-ring packing provides the contact surface for absorption of P₂O₅ in acid.

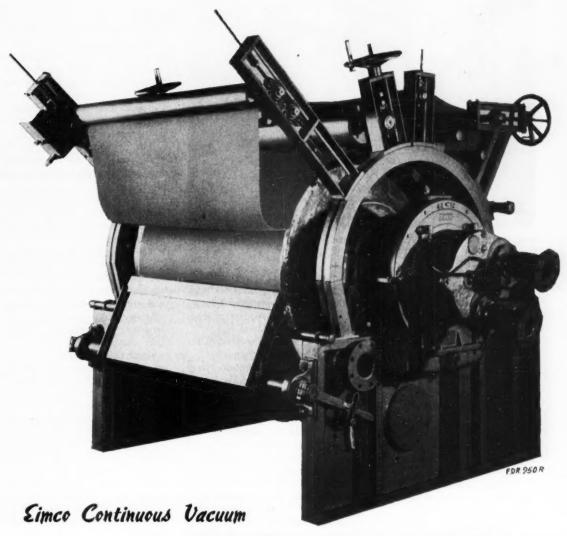
 A combination continuous unit where the phosphate solution is dried, calcined to form polyphosphate, and cooled. This is all done in a single unit, contrasted to a drum dryer-calcining kiln arrangement.

Here's how Shea overcame the disadvantages of conventional design:

• A horizontal, instead of vertical design, Shea's converter is shaped like a 55-ft. long quonset hut, or "beehive." It's claimed to have the largest U.S. capacity for a single combustion chamber—12 tons per hr. of acid. Good structural stability, uniform water distribution, are some of the advantages over o'der types.

• A 57-ft. high spray dryer for drying the phosphate solution prior to calcining. A Shea design, it readily lends itself to continuous flow, requires little maintenance and is inexpensive to build.

► Troublesome Combustion Chamber—There has always been general



Filters Using Compression Blankets

Another example of the many types of Eimco Continuous Vacuum and Pressure Filters. Filters of this type have been in use in many plants and provide many advantages where the material to be filtered produces a flocculent solid type cake.

Eimco filters of the type shown above, introduce a wash spray to the cake formation immediately after it emerges from the liquid in the tank and the compression blanket binds the cake to drum within a few inches of the slurry level. The blanket covers the cake to the blow zone above the scraper blade.

This type Eimco filter prevents cake cracking, greatly improves washing and on some types of filter cake, will reduce moisture content in the cake by 8-10%. Write for more information.

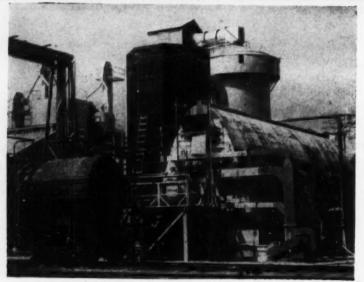
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You Can't Beat An Eimeo!





ANOTHER NEW DESIGN-combustion chamber at the Shea Chemical plant.

dissatisfaction with the conventional phophorus burner, where phosphorus is oxidized to phosphoric anhydride (P₄O₈).

Hot P_sO_s vapors are very corrosive, and usual practice has been to build a vertical chamber out of graphite blocks. This chamber has several disadvantages: It's difficult to construct because of the poor structural stability of graphite; it's subject to leaks and requires constant maintenance; cooling water distribution down the exterior sides is not uniform, resulting in poor temperature control.

Virginia-Carolina's plant at Fernald, Ohio, incorporates answers to many of these disadvantages.

Feeding three raw materials to the nozzle in the chamber (air, phosphorus and atomizing steam) the flame temperature of the reaction reaches 3,600 F.

An important piece of equipment, the phosphorus combustion chamber includes many novel and new ideas on chamber design.

Stainless steel plays a significant part here as one of the materials of construction.

And stainless steel in turn permits the use of pressure, resulting in a smaller chamber.

▶ Another Problem Solved—One of the byproducts of combustion is a viscous, glassy liquid—metaphosphoric acid. It can collect in the bottom of the chamber and leads to costly shutdowns.

The nozzle in V-C's design points downward at the base. Combustion takes place close to the layer of meta acid at a temperature high enough to vaporize the acid. Some meta is always formed during combustion, but vaporization tends to keep it at a low level.

This technique also permits the design of a smaller chamber.

Leaving the combustion chamber, phosphoric anhydride goes to the hydrator. Here 75-85% phosphoric acid is made by absorbing P₂O₈ vapors in weak phosphoric acid. Again the material of construction is stainless steel, and a cooling jacket makes it possible.

Vapors exiting from the hydrator are scrubbed free of entrained acid. Some of the weak entrained phosphoric acid is collected in a cyclone and the remainder in a glass wool filter. After a concentration adjustment to 30%, this is recycled back to the hydrator and scrubbing system. V-C has eliminated the Cottrell precipitators—commonly used in many plants to recover acid.

In the phosphate building, soda ash reacts with phosphoric acid forming a phosphate solution (for tripoly, one mole of mono- to two moles of disodium phosphate). This solution is sprayed into a continuous unit. Here drying, molecular dehydration, conversion to polyphosphate, annealing and cooling take place.

▶ Many Benefits—All these improvements show up in yield figures. About 95% of the total acid made is collected in the hydrator itself, and 5% in the clean-up system. In a hydrator-Cottrell system, the ratio is about 40:60. Why is this?

Mainly because the packing in the hydrator permits adequate contact time between vapor and Lquid.

Another important point-recovery of acid from P₂O₅ vapors is close to 100%,

Besides these benefits of the new designs, there's a saving in manpower requirements.

This is brought about by the heavy emphasis on instrumentation and controls throughout the plant.

Installed to control the many important operating conditions, they permit a relatively small number of plant personnel.

▶ How Shea Approaches Problem—Completed in just over six months the Shea plant also includes an efficient hydration (packed tower) and scrubbing system. But the one striking piece of equipment at Jeffersonville is a horizontal combustion chamber, 55-ft. long, 15-ft. wide at the base, and 15-ft. high, shaped like a quonset hut and constructed of 3-in. thick graphite blocks. Two burning nozzles are used—one at each end.

The quonset hut design also gets around many of the disadvantages of older designs. It has structural stability and is easier to build. Water distribution over the chamber is more uniform—and this means better temperature control, less meta formation. Also, there is little in the way of leakage through the roof.

In the phosphate building soda ash reacts with phosphoric acid in an agitated kettle. But the soda ash and a portion of the acid is "prereacted" in a continuous-flow paddle mixer. Here most of the CO_a comes off and is removed through an exhaust system. The reaction is completed in the kettle, but use of the paddle mixer practically eliminates the usual foam problem.

Phosphate solution is dried in a 22-ft. dia. by 57-ft. high spray dryer (designed by Shea). From there the phosphate flows continuously to a gas-fired calciner, where internal water is removed, forming sodium tripolyphosphate or pyrophosphate.

The result is polyphosphates with twice the volume per unit weight of the usual product.

Where is "Lead" used

to control Sulphuric Acid Corrosion?

Find H₂SO₄ and you're apt to find lead.

Lead's fought H₂SO₄ corrosion for several centuries and its usefulness grows steadily.

The past few years have seen lead go into new types of electrostatic and sonic air purifiers; into new waste treating equipment; bubble towers; devices for processing, recovering and storing sulphuric acid and other chemicals.

And new forms of cage-type sheet lead structures have been developed...along with new bonding and strap lining methods, new constructions for high temperature erosion-corrosion service, automatic stud welding. New, non-destructive tests for bonds, linings and welds have been devised.

More is coming soon...coming from research into anodic corrosion of lead in sulphuric solutions... into lead's age hardening and creep properties... into unknowns.

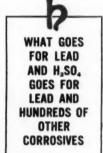
What about lead in your own acid handling equipment... considered in the light of this new lead technology? It's worth thinking about, and...

Aluminum sulphate. (From Lee's "Materials of Construction for Chemical Process Industries") Thickener for 80 per cent through 200 mesh countercurrent decontation Ba S for Crushing Bauxite and feeder Fe2 (50,) arindina Bauxite Feeder Glue Sulphuric acid 60 deg. Bé. Live steam Reaction agitators Thickeners for countercurrent decantation Pump Pump Solids П to waste Cooling 59-62 35 deg. Be Grinding, deg Be floor Packing Open Shipping evaporato

When you think of Lead ...

think of National Lead

Trap



National Lead puts lead in your hands in any grade you may require and in every conceivable form—sheet, pipe, coils, fittings, valves, pumps and vessels. Or you can have National Lead fabricate lead equipment to your specifications.

So put National Lead first in your thinking when you want to combat corrosion. Call on National Lead for technical assistance. Ask for a copy of the new booklet on "Chemical Lead Products."

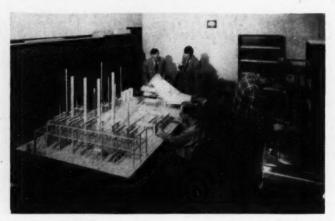
New Yor

3

National Lead Company

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Ltd.).

Lead



Model shop helps engineers plan expansion

Rather than farm out its scale model jobs, Commercial Solvents Corp. of Terre Haute, Ind., has installed its own model shop to supplement engineering planning. The first model (above) is of company's \$5 million nitroparaffins plant now being built at Sterlington, La. Scale is \$\frac{1}{2}\$ in. to the foot.

Equipment includes a lathe, drill press, power saws and other necessary tools for this small scale work. Arrangement and even size and shape of this equipment can be changed readily to accommodate new ideas in plant design and layout at a minimum of time, trouble and expense.

Standard Completes All-New Oil Refinery

Up near the top of the country's wheat belt, at Mandan, N. Dak., a new 30,000 bbl. per day refinery, built from scratch, has been dedicated and is now undergoing shakedown runs. The proud owner: Standard Oil Co. (Ind.).

Although most refineries nowadays are pretty much alike, this one has one definitely unusual feature—"on the fly" refining. Crude oil is processed into finished products in one continuous operation without intermediate storage in rundown tanks. According to refinery manager Thomas Stockdale, "No one piece of equipment operates by itself in the refining process here all must work perfectly together or we don't operate at all."

And it's multiple processing, including distillation, catalytic eracking, vapor recovery and polymerization. Most products will move castward through pipelines.

Armour Product Line To Be Made in Britain

Sometime next year, the chemicals now made solely in the U.S. by Armour & Co. will be available overseas from British production. Hess Products, Ltd., with its own funds, is building a \$400,000 plant near Rochdale, Lancashire, under licensing agreements with Armour for that purpose.

Hess will make aliphatic nitrile compounds by catalytically treating fatty acids with ammonia. The nitriles, in turn, will be hydrogenated to various amines. Further reaction of the amines with organic acids will produce a variety of water-soluble surface active agents.

Because sale will be on a sterling rather than dollar basis, it's expected that many segments of British industry will be able to make greater use of these products than is now possible. Armour & Co., Ltd., London, will distribute the chemicals at home and abroad.

News Briefs.

Epoxy resins: Dow Chemical Co. has been licensed to operate under the epoxy resin patents held or controlled by Devoe & Raynolds Co. Shell Chemical Corp. and Bakelite Co. have similar working agreements.

Oil stock: Standard Oil Co. (N. J.) is trying to acquire at least 80% of the common stock of Humble Oil & Refining Co. Standard now owns about 72% of the outstanding shares of that affiliate.

Refinery: Tide water Associated Oil Co., which earlier this year revealed plans to build a new 100,000 bpd. refinery to replace an outmoded refinery at Bayonne, N. J., now indicates the plant's capacity may be as high as 130,000 bpd. Site is still undetermined, but the firm has several options on land in the Delaware River Valley.

Polyesters: Du Pont's new plant for manufacture of Mylar polyester film at Circleville, Ohio, is now on stream. And the company has cut prices 15¢ a lb. on all types of Mylar except 25 gauge, the thinnest film.

Emulsifiers: Atlas Powder Co.'s new emulsifier plant at Brantford, Ont., is in production. It's the largest installation of its kind in Canada.

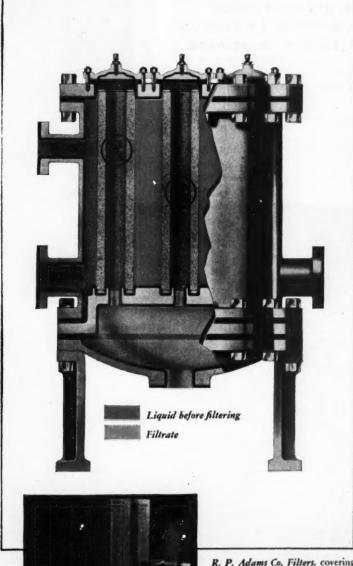
Oil financing: Continental Oil Co. plans a \$100 million debenture issue, the largest money-raising operation in its history. About \$45 million will be used to repay short-term loans, the rest for development of the firm's oil and gas properties.

Newsprint: Bow:ter Southern Paper Co., a subsidiary of Bowater Paper Corp., Ltd., of London, has dedicated a \$60-million paper mill at Calhoun, Tenn. Annual capacity is 130,000 tons of newsprint and the entire output for the next 15 years has already been sold.

Another Norton

R on the job!

Outstanding performance of Adams filters aided by Norton seamless porous tubes



R. P. Adams Co. Filters, covering many chemical filtering services, deliver sparkling clear filtrate and insure quick cleaning without disassembly. Adams filters handling acid or neutral solutions are equipped with Norton seamless porous tubes, engineered and prescribed for faster, more thorough filtering and backwashing.

Besides assuring fast, thorough filtering action, Norton porous tubes are extremely easy to clean by backwashing. Here are several good reasons why they excel in these two primary essentials of efficient, economical filter performance:

- Norton porous tubes are made of ALUNDUM* (fused alumina) engineered by Norton for chemical stability, inertness and other properties necessary to withstand acid, neutral and slightly alkaline liquors.
- Like all Norton ALUNDUM porous mediums they are made with the patented controlled structure process that assures even distribution of pores for uniform passage of both filtering and backwashing liquids.
- They are seamless, providing unobstructed diffusion over their entire area

 — for further efficiency in both filtering and cleaning.

Other big advantages

of all Norton porous mediums include ease of installation and exceptional resistance to breakage and chipping. Available in sizes and open-pore ratios to meet your needs, they're engineered to last longer and cut your operating costs—and they're prescribed for a wide variety of chemical services, such as filtering water or solvents... cutting oils, wine, etc... reclaiming cleaning fluids and industrial waste... and for boiler feed water treatment.

See your Norton Representative for further facts or write, describing your requirements, to NORTON COMPANY, 511 New Bond St., Worcester 6, Mass. Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.



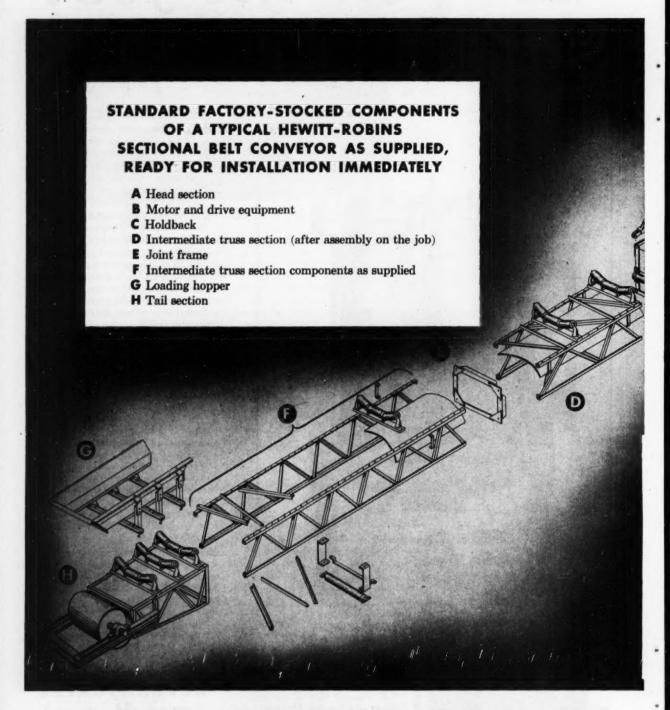
REFRACTORIES

Engineered... R... Prescribed

Making better products... to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Order Your Belt Conveyor

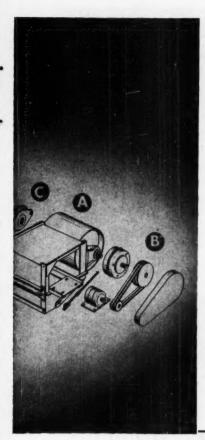




HEWITT-ROBINS

EXECUTIVE OFFICES, STAMFORD, CONNECTICUT

Right From Factory Stock



Save Time and Money... Install your own
Hewitt-Robins Sectional Belt Conveyor
from Easy-to-assemble Factory-built Components

Now, for the convenience of large and small plant operators alike— Hewitt-Robins offers a standardized sectional conveyor adaptable to a wide variety of uses.

Hewitt-Robins Sectional Conveyors consist of completely assembled factory-stocked components that can be quickly and economically installed and maintained by your own personnel.

When you order a Hewitt-Robins Sectional Conveyor you can be sure of prompt delivery . . . all components and parts from machinery to belting are shipped to you direct from standard factory stocks . . . saves you time and saves you money.

For prompt information about the Sectional Conveyor and any other Hewitt-Robins bulk material handling products, contact the Hewitt-Robins office nearest you or write direct to Passaic, New Jersey.



Write for Bulletin #132-B on your company letterhead

Here is a partial list of HEWITT-ROBINS PRODUCTS that will help you cut handling costs and increase operating efficiency

MACHINERY:

Belt Conveyors
Belt & Bucket Elevators
Car Shakeouts
Screen Cloth
Vibrating Conveyors & Screens

INDUSTRIAL RUBBER PRODUCTS:

BELTING:

Conveyor Elevator Transmission

HOSE

Hewitt-Robins makes over 1,000 different types of industrial rubber hose, including Twin-Weld®, the patented twin-line welding hose.

For information and service on industrial rubber products, contact your Hewitt-Robins Industrial Supply Distributor. Through his complete stock of Hewitt-Robins Rubber Products, and his familiarity with local field conditions, he can fill your supply needs promptly and correctly. See Classified Phone Book for the Hewitt-Robins Industrial Supply Distributor serving your area.

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ENGINEERING DATA

APPLICATION: Designed to handle bulk and packaged materials where special limitations and conditions do not require the use of custom-engineered belt conveyors.

MATERIALS HANDLED: Sand, gravel, run-of-mine ore, coke, stone, coal, gypsum, grain, sugar beets and any other bulk materials that can be handled more efficiently and economically by belt conveyor.

CAPACITIES: From 20 to 500 TPH at belt speeds from 200 to 450 feet per minute.

STANDARD WIDTHS: 18", 24", 30", 36".

LENGTH: From 15'6" up to any

length consistent with good conveyor practice...inclines up to 22½°.

STANDARD HORSEPOWER: From 2 to 30 hp.

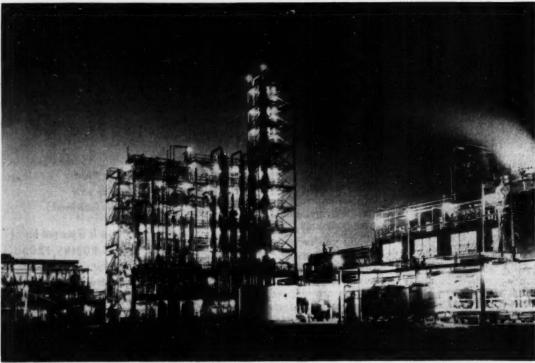
IDLERS: 4*or 5* diameter troughing and return idlers available. Both types have exclusive Hewitt-Robins patented Triple Grease Seal and oneshot lubrication.

BELTING: Complete selection of all Hewitt-Robins standard stocked belts. Special belts available when necessary.

INSTALLATION: All standard factory-assembled components are clearly labeled and shipped with complete instructions, for quick, easy assembly by your own personnel.

INCORPORATED

FOREIGN SUBSIDIARIES: Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • EXPORT DEPARTMENT: New York City.



NIGHT SHIFT takes over at Eastman's Longview, Tex., plant where . . .

Isobutyraldehyde Begets New Chemical Family

Multipurpose chemicals readily derived from a single, abundant source—that's the backbone of Eastman Chemicals' isobutyraldehyde program.

Like a studhorse valued more for breeding than for running, isobutyraldehyde performs best today as sire to a new class of attention-attracting chemicals. Some already are tonnage items. Others are poised in pilot plant fashion to move strongly into markets as they crystallize. All have, or are reasonably assured of, attractive prices, stemming as they do from a common economical raw material, isobutyraldehyde.

A fairly young entry in the middleweight organic field, isobutyraldehyde first started to stream in quantity (via the Oxo process) from Texas Eastman's Longview, Tex., plant early in 1952. Company spokesmen won't say how much isobutyraldehyde comes out of Longview these days; "total butyraldehyde production, both normal and iso, is in excess of 100,000 lb. a day" is as far as they care to go. Nor will they talk in figures about the market, present or expected, for isobutyraldehyde or its derivatives.*

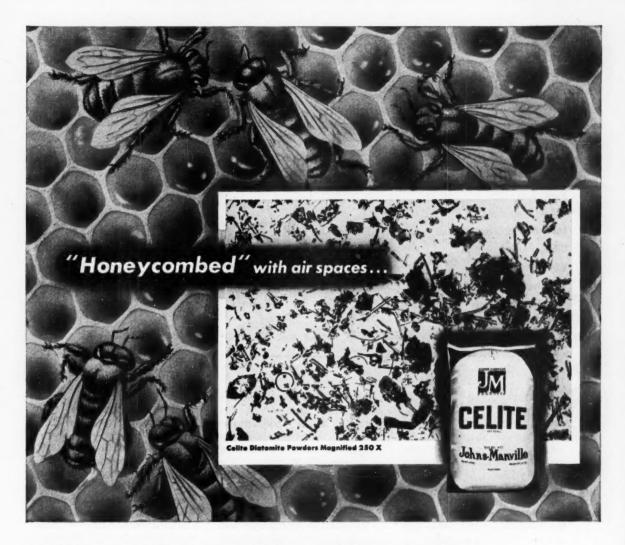
*Not, at any rate, until they know more about Carbide and Carbon's plans for its new Texas City plant, sized for 60 million pounds of chemicals a year via the Oxo process. But the company wants to broaden these markets, nail them down, and is naturally happy to discuss the jobs isobutyraldehyde is doing in industry and the research lab.

► Sweeter and Lighter—Eastman is pushing its two top volume isobutyraldehyde derivatives, isobutyl alcohol and isobutyl acctate, as supplements or replacements for the normal butyls in many applications.

Why switch to isobutyls? Not only do they perform as well as the *n*-isomers in most cases but they offer three important plusses to the chemical processor:

• Lower cost: isobutyl alcohol and acetate sell for about 2¢ a lb. less than the n-butyls.

• Milder odor (especially the acetate): an advantage in lacquer



Celite Powders provide bulking action

3 to 10 times greater than any other inert mineral filler

Pound for Pound, Celite* diatomite powders supply more bulking action than any other inert mineral filler because their cubic volume is 3 to 10 times greater. Celite's unique "honeycombed" structure is composed of microscopic, irregularly shaped particles that won't pack down. In mass they weigh only about 10 lbs. per cubic foot.

That's why Celite is so widely used to add bulk and body to industrial formulations. For example, it extends

white pigments in paints and papers ... it improves dispersion of insecticides and fertilizers . . . it fluffs up dry powders such as household cleansers.

Also, from Celite's "honeycombed" structure comes its great absorptive capacity. This characteristic is profitably utilized to keep powders freeflowing . . . to provide a medium for shipping or storing liquids in dry form. And because of the physical structure of its individual particles, Celite has become the outstanding

flatting agent for paints . . . it serves as a mild, non-scratching abrasive for fine polishes . . . it improves the surface appearance of plastics.

Which of the many Celite advantages can you use to build product performance or cut costs? A Johns-Manville Celite Engineer will gladly discuss your problem, without obligation. For his services or more information, write Johns-Manville, Box 60, New York 16, New York. In Canada, 199 Bay St., Toronto 1, Ontario.

•Celite is Johns-Manville's registered Trade Mark for its distornaceous silica products.



Johns-Manville CELITE INDUSTRY'S MOST VERSATILE MINERAL FILLER

Products on these pages this month made news . . .

	Page number is also Reader Service code number		
Chemicals from isobutyraldehyde140A	Lighter colored plasticizers		
New di-isocyanates144A	Heat proof titanium alloy150C		
High-heat resistant paint144B	Latices for textile finishing150D		
Touchy ammonium nitrate146A	Strong plastic laminate150E		
Super-fine silica146B	Hypertension drug		
Oil well opener146C	Rubber softener and tackifier		
Industrial detergent146D			
Glass cloth coating	Binder for glass mats		
Rust remover	Diatomic iodine150I		
Ceramics in solution148C	Infiltrase quickens drug action		
Universal pigments150A	All-purpose grease		

. . For more about any item, use Reader Service postcard (p. 449)

manufacturing plants where vapor concentrations of strong-smelling solvents are objectionable to workers. Plasticizers derived from the "sweeter" isobutyls will have wider applications in food and perfume packaging films.

• Lower specific gravity: an important dividend for the protective coatings industry which buys raw materials by the pound and sells its products by the gallon. In a 60,000-lb. tank car of isobutyl acetate this density difference effects a bonus of 115 gal. of solvent.

Other isobutyl features valuable in some applications are: lower boiling point, faster drying rate, greater solubility in water.

▶ Newcomers—Eastman's latest crop of isobutyraldehyde derivatives include neopentyl glycol, isobutyric acid, isobutyl isobutyrate and 2,2,4-methyl-1,3 pentanediol. The first three are already available in semicommercial quantities. All four are producible by nearly kink-free processes and await only further market acceptance to get fully under way.
▶ Neopentyl Glycol—A condensation product of formaldehyde and

► Neopentyl Glycol—A condensation product of formaldehyde and isobutyraldehyde with subsequent reduction. Introductory price—45¢

a lb.

As a basic raw material for unsaturated polyester resins, neopentyl glycol imparts good styrene solubility, high tensile and flex strength. Mixed polyurethanes containing the glycol show good elasticity at 10-60 C., are useful in impregnation of fabrics. The glycol also reacts with phthalic and maleic anhydrides to form moldable alkyd resins which are compatible with cellulose acetate.

Neopentyl glycol combines with monobasic acids like 2-ethylhexoic and pelargonic, or with dibasic acids like phthalic, sebacic and adipic, to yield low viscosity plasticizers which impart excellent mechanical and permanence properties to vinyl films.

► Isobutyric Acid — Air oxidation product of isobutyraldehyde. Price —33¢ a lb.

Its potassium salt is a solubility promoter in caustic extraction of mercaptans—especially those with branched chains of three or more carbons — from sour petroleum crudes. Water solubility of octylalcohol and cyclohexane is increased through use of sodium butyrate.

Isobutyric esters of glycerin, trimethylolethane and trimethylolpropane are promising plasticizers. Diethylene glycol di-isobutyrate is a suitable plasticizer for cellulose acetate (the n-butyl ester is not compatible). Many of isobutyric acid's esters possess desirable odor and flavor characteristics.

► Isobutyl Isobutyrate—A distinct fruity odor and flavor mark this compound for use in perfume and flavoring formulation. Other uses: in various insect repellents; as a solvent for ink oils.

▶ 2,2,4-Trimethyl-1,3-pentanediol—Condensation product of two moles isobutyraldehyde, with subsequent reduction.

Reaction with dicarboxylic acids gives esters which are suitable candidates for hydraulic fluids and lubricant additives in the high boiling field. Low temperature lubricants result from esterification with branched chain acids like 2-ethylhexoic.

Combination of this diol with maleic and phthalic anhydrides yields moldable alkyd resins completely compatible with cellulose esters.

▶ Do It Yourself—So far we've talked only of Eastman's isobutyraldehyde derivatives because virtually all production of the isoaldehyde is immediately used at Longview to prepare them. Only the small remaining fraction is sold outright: a CP, anhydrous grade which goes to manufacturers of pantothenic acid—who use the aldehyde as starting

Carbide's

ANOLAMINES



FOR EXCELLENT CHILDSifiers

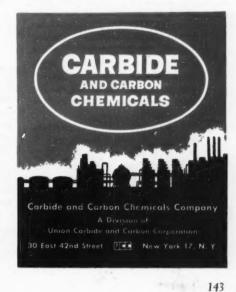
MONOETHANOLAMINE and TRIETHANOLAMINE combined with fatty acids produce amine soaps that are important emulsifiers in the manufacture of "soluble" oils. When triethanolamine oleate is properly formulated in "soluble" mineral oils there is no separation of the soap and oil in either open or closed containers. Furthermore, relatively small proportions of these emulsifying agents are required to produce a good "soluble" oil.

Triethanolamine is a good emulsifying agent for cosmetic preparations. The detergent properties of this amine soap imparts a cleansing action to the cream, even when the soap is present in comparatively low concentrations.

Monoethanolamine and diethanolamine also enter into condensation reactions with fatty acids to yield an important class of textile assistants and synthetic detergents.

IN ADDITION-CARBIDE's monoethanolamine and diethanolamine are efficient agents for the removal of carbon dioxide and hydrogen sulfide from refinery, natural, and flue gas streams.

Your CARBIDE Technical Representative can discuss in detail additional technical information as well as purchasing and shipping data for these ethanolamines. Call him-he's as near as your phone. In Canada: Carbide Chemicals Sales Com-pany, Division of Union Carbide Canada Limited, Toronto.



material—a nutritional factor incorporated in poultry feed.

Eastman would, however, be very willing to market isobutyraldehyde, as is, to chemical processors and let them make their own derivatives.* Here, according to company research, is a partial listing of the jobs isobutyraldehyde can do as an economical intermediate (It should be noted in evaluating this aldehyde that its aldol reaction is completely reversed in the presence of mildly alkaline catalysts at 60 C.; this means it can be used in reactions ordinarily limited to aromatic aldehydes and formaldehyde):

• Resins: Melamine and ureaformaldehyde resins give condensates which when etherified with isobutyl alcohol, form alcohol solube resins. Isobutylamine and crotonic acid fuse to form alcoholsoluble resins suitable for sizes and wood sealers; isobutylamine and polyfunctional carboxylic acids, such as lactic, benzoyl-benzoic and naphthenic, form varnish resins. Phenolic resins modified with isobutyraldehyde yield soluble, permanently infusible resins.

 Corrosion Inhibitors: Diisobutylthiourea is a good one, can be used in gas condensate corrosion control, acid cleaning and derusting, and for boiler scale removal.

• Gasoline Additives: Addition of 4% isobutylamine to aviation fuels containing 4.6 ml. T.E.L. per gal. gives 10% better anti-knock performance.

 Plasticizers: Di-isobutyl sebacate imparts low temperature flexibility to butadiene-acrylonitrile elastomers. Di-isobutyl adipate lends color stability to vinyl chloride resins. D-isobutyl adipate has been approved as a plasticizer for food packaging films.

 Textile Assistants: Addition product of formaldehyde and 5isopropylhydantoin (made from isobutyraldehyde and ammonium carbonate) helps applying an antishrink finish to cotton and rayon.

· Vinyl Monomers: Dehydro-

genation of isobutylnitrile yields methacrylonitrile which finds application in Buna-N rubbers. Copolymers of methacrylonitrile with acrylonitrile have better improved solubilities in common organic solvents and form fiber with high elongation.

Do Nutshell—The Oxo reaction, by which Eastman makes isobutyraldehyde, is a relatively new unit process for the production of aldehydes and alcohols. It involves the simultaneous combination of hydrogen, carbon monoxide and an olefin to yield an aldehyde with one more carbon than the feed olefin.

At the Longview plant, propane from nearby oil fields is cracked to propylene, natural gas to CO and H₂. Combination of these components at 130-160 C. and 1,500-3,000 psi., in the presence of a cobalt-containing catalyst, yields a mixture of normal and isobutyraldehyde. The proportions of each isomer depend to a great extent on the operating pressures and temperatures employed in the reaction H₂, CO and propylene.

This last-mentioned yield control gives Eastman production flexibility, for it enables the company to meet a sizeable increase in the demand for the isoaldehyde without upsetting the scheduled volume for the normal isomer.

New Diisocyanates

Their lower order of volatility permits use at higher temperatures.

Isocyanate technology has two new materials available in quantity to play with: bitolylene diisocyanate (TODI) and dianisidine diisocyanate (DADI). Like other isocyanates the new varieties react with polyesters to produce rigid and flexible foams. And they show promise in the manufacture of adhesives, fibers and elastomers, and of resins for molding and coating applications.

But TODI and DADI possess certain advantages, too:

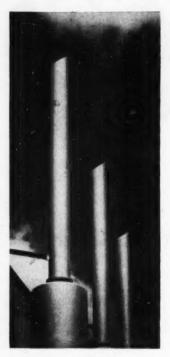
• Low order of volatility . . . minimizes hazards from vapor ex-

posure and permits use at higher temperatures.

• Presence of substituent group adjacent to each isocyanate group . . . has a moderating effect, allows greater latitude in time-temperature relationships in disocyanate reactions.

• Spatial configuration (rigid symmetrical system of two freely rotating benzene rings) . . . imparts more strength to resinous materials.

-The Carwin Co., North Haven, Conn.



1,000 F. for 21/2 Years

These gleaming diesel exhaust stacks sit astride Reynolds San Patricio reduction plant near Corpus Christi, Tex. In February, 1952, all such chimneys received a coating of aluminum-silicone paint applied in this manner: first a gray primer was laid on and burned in by a 24 hr. run of the diesels; the engines quiet once more, a top coating followed, composed of a silicone resin combined with aluminum pigment; again the engines brought the stacks up to full temperature. Today, after 2½ yr. of high heat service—normal stack temperature is 950 F., with 1,100 F. the rule on occasion—the stacks look almost as good as the day the paint was applied.-Reynolds Metals Co., Louisville, Ky. 144B

As a provocative invitation, Eastman is plummeting its asking price on CP isobutyraldehyde from 50¢ a lb. (carload drums) to 27.5¢ a lb. and is offering for the first time a technical grade at 19.5¢ a lb. (tank car).

LOW-COST INTERMEDIATES IN TANK-CAR QUANTITIES

This versatile trio represents the most economical source of the amine group because of their low equivalent weights and moderate prices. Marketed by CSC in both anhydrous and aqueous forms, they are available for shipment in large-volume quantities (tank cars) as well as in drums and smaller containers. Write for latest Technical Data Sheet. Industrial Chemicals Sales Dept., Commercial Solvents Corporation. 250 Madison Avenue. New York 16. N. Y.

MONOMETHYLAMINE CH₃ NH₂

Uses

Manufacture of amide and sulfonated amide-type detergents and surfactants. Synthesis of caffeine, aminophylline and desoxyephedrine. Manufacture of photographic chemicals, the explosive tetryl, amide-type plasticizers, ion-exchange resins, corrosion inhibitors and paint removers.

Properties

Molecular Weight	31.06		
Beiling Point at 760mm, °C	-6.79		
Flash Point, Tag Open Cup, °F	34	(30%	SOI
Density at 20°C	0.912	(30%	sof
Weight per U.S. Gallon at 68°F, lbs.	7.6	(30%	sol

DIMETHYLAMINE (CH₃)₂ NH

Uses

Raw material in manufacture of thiuram sulfide-type vulcanization accelerators and of dimethyldithiocarbamic acid salts used as fungicides. Neutralizing and solubilizing agent in preparation of concentrated solutions of 2,4-D salts. Manufacture of anti-malarials.

Properties

Molecular Weight	45.08		
Boiling Point at 760mm, °C	6.88		
Flash Point, Tag Open Cup, °F	54	(25%	sol)
Density at 20°C	0.921	(25%	sol)
Weight per U.S. Gallon at 68°F, lbs.	7.7	(25%	sol)

TRIMETHYLAMINE (CH₃)₃ N

Uses

Preparation of long-chain quaternary ammonium compounds used as softeners, lubricants and waterproofing agents for textiles. Used with benzoyl peroxide to "set" methacrylate resins. Synthesis of cationic surface-active agents.

Properties

Molecular Weight	59.11
Boiling Point at 760mm, °C	2.87
Flash Point, Tag Open Cup, 6F	38
Density at 20°C	0.91
Weight per U.S. Gallon at 68°F, lbs.	7.6



INDUSTRIAL

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Sometimes it explodes, sometimes it merely burns. Prevention of both is more certain now.

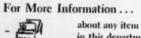
Why did ammonium nitrate explode from a fire on shipboard at Texas City in 1947? Why does it, in warehouse fires, burn itself out instead? The answer-pressure.

In a fire, ammonium nitrate tends to decompose to gaseous ammonia and nitric acid, a heat-absorbing reaction which proceeds rapidly enough at or near atmospheric pressure to hold temperatures below the explosive point. Higher pressures, however, such as those quite likely to exist in the holds of ships, repress or prevent this endothermic dissociation and may permit the explosive temperature to be reached.

Recent research has also discovered that for every material and temperature there is a critical size below which spontaneous heating will not take place because the heat generated can escape. Above this size spontaneous heating does take place, slowly at first, but increasingly faster since the heating rate itself is dependent on temperature. At excessive temperature such spontaneous heating can actually cause a fire, a fact not generally accepted before Texas City.

A much more significant discovery, though, are the critical temperatures below which uncontrolled heating cannot occur regardless of

With well understood limits of temperature and pressure thus established, explosions, fires and even spontaneous heating can be prevented and all types of ammonium nitrate can be shipped anywhere with minimum risk.-Arthur D. Little, Inc., Cambridge 42, Mass. 146A





in this department, circle its code number on the Reader Service Postcard inside the back cover.

Super-Fine Silica

Remarkably low particle size makes for huge surface area.

Silica with a higher degree of particle separation (only 10-20 millimicrons) and purity (99%) than that formed by precipitation methods is now being made semicommercially in this country for the first time.

Produced by burning silicon tetrachloride in combustible gases, a process invented in 1933-36, Dow Corning Silica has a prodigious surface area and oil absorption capacity, is easily dispersed in elastomers and in solvent, oil or water based systems.

These properties suggest the silica's use as reinforcing filler for synthetic rubber and plastics; flatting agent and extender for protective coatings; lubricant thickener; and textile finishing additive. Its price is still high, though-in the range of \$0.80 a lb.-and will have to be reckoned with .- Dow Corning Corp., Midland, Mich. 146B

Oil Well Opener

Surfactant breaks water block, swells nation's petroleum potential.

Oil men have a new ally in Atpet 931, a non-ionic chemical detergent with the ability to stimulate old wells, restore dead ones and complete new ones blocked by water.

In a process developed and field

tested by Stanolind Oil & Gas Co. of Tulsa, crude oil containing 1% Atpet 931 is injected into the sick well-usually 10 to 100 gal. of detergent per well.

Results of such field tests conducted on 90 wells: total cost, \$39,-000; total increased production, 1,217-bbl. daily; average treatment cost, \$430; average payout time, about 20 days; cost per daily barrel of increased production, \$32.

Water which penetrates oil bearing sand and makes it difficult or impossible for the crude oil to flow to the well hole has plagued the petroleum industry in the past. Atpet 931, one of the more effective remedies for this water block, releases interfacial tension between oil and water and permits oil flow again through the strata.

Atpet has other applications, too:

· Completions - where water from mud or drilling operations may damage formation. And Atpet may serve as a perforating fluid for water sensitive formations.

· Fracturing-ahead of fractur-Produced by burning silicon tetraing jobs, to combine both methods of production stimulation.

· Cementing-ahead of cementing, when water from the cement may damage the producing formation.

· Well logging-in procedures involving loading the well with water, Atpet may aid in regaining production.-Atlas Powder Co., Wilmington 99, Del. 146C

Industrial Detergent

Contains no caustic, is nontoxic, nonflammable, does not attack aluminum.

Planisol, a general purpose detergent, emulsifies all fats and oils and can be used for a wide range of jobs-from cleaning large vessels heavily encrusted with polymerized oil to sanitizing food processing equipment. Manufacturers of some types of fat and oil processing equipment will be interested to know that Planisol does not attack aluminum and cleans it as readily as carbon steel, stainless steel and other materials.

Planisol is highly alkaline yet

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NOW AVAILABLE! Greatly increased production of the high quality Solvay Potassium Carbonate that has long set the standards for the industry. Users of potassium carbonate can now be assured of prompt deliveries even during periods of heavy demand.

Now, more than ever before, it pays to specify Solvay when ordering potassium carbonate. The quality is doubly guaranteed by Solvay's 73 years of manufacturing experience and the world's newest, most modern equipment . . . and prompt deliveries, even during peak seasons, are assured by the greatly expanded production facilities.

SOLVAY PROCESS DIVISION ALLIED CHEMICAL & DYE CORPORATION 61 Broadway, New York 6, N. Y.



contains no caustic and can be safely handled by plant personnel. It's nontoxic, nonflammable, has excellent bactericidal properties and a phenol coefficient of 2.0.

According to recent tests in a plant that cleans 20-25 tank cars a day, one pound of Planisol is equivalent to four pounds of caustic-bearing detergent. And Planisol-washed tanks were odor-free after one cold water rinse; tanks washed with the caustic cleaner still had a musty odor after several hot water rinses.—The Girdler Co., Louisville, Ky. 146D



Glass Cloth Coating

Silicone rubber imparts improved crease resistance,

An improved grade of Silastic 132 silicone rubber coating for glass cloth has been developed, featuring retention of dielectric strength and better crease resistance.

10 mil coatings of the new Silastic 132 on ECC 116 heat-cleaned glass cloth hold their original average lengthwise tensile strength of 140 pounds per inch through four creases. Crosswise tensile strength averages 135 lb. per in., uncreased and 130 after four creases. After 96 hr. at 200 C. lengthwise average is 145 lb., uncreased and 95 lb. after four creases.

Similarly coated samples measured with 4-in, electrodes have a dielectric strength of 1,100 volts per mil both as is and after 21 days at 250 C.

In the picture above glass cloth coated with Silastic 132 springs back unchanged after being rolled; cloth treated with comparable material begins to assume a permanent crease.—Dow Corning Corp., Midland, Mich. 148A



Rust Remover

Non-electrolytic alkaline cleaner works in but two steps: a dip and pressure rinse.

Rust, acid-proof paint, baked lacquer and red oxide primer are stripped from ferrous metal surfaces by Rustgon, a non-electrolytic alkaline cleaner. Elaborate multitank installations are unnecessary; parts to be cleaned are merely immersed in a Rustgon hot tank (see cut) and then rinsed with air, water or steam. There's no need for precleaning, neutralizing or dipping for rust prevention.

Rustgori contains no cyanide compounds, emits no corrosive fumes, needs no expensive electrolytic equipment (with attendent danger of hydrogen embrittlement). It can be used as received, without dilution or mixing.

Slightly pitted rust is removed in less than a minute while heavy rust and multiple coatings of paint require only a few minutes' immersion.—Turco Products Inc., Los Angeles 1, Calif. 148B

Ceramies in Solution

Nonbrittle, self-bonding coatings can be applied to surfaces at a few hundred degrees Fahrenheit.

A new process technique, "solution ceramics," gives adherent, nonbrittle inorganic coatings on almost any heated, clean, solid surface at relatively low temperatures—400 to 700 F. (Zirconia, whose melting point is nearly 5,000 F. can be applied to surfaces heated to less than 500 F.).

• Controlled thickness: Since solution ceramics are deposited from true solutions their rate of application (and thickness) can be accurately regulated by controlling the concentration of these solutions. Coatings only a few millionths of an inch thick have been produced.

• Ability to be modified: Solution ceramic coatings may be easily covered or impregnated with other materials—and without loss in adherence. Metallic and other inorganic precipitates, waxes, resins or silicones can be used. Solution ceramic calcium oxide may be converted to calcium carbonate by dry CO_s treatment; solution ceramic silver oxide is reduced to metallic silver with hydrogen and ammonia.

 Adhesion: These products, unlike other sprayed ceramics, need no bonding agents. So long as the solid base is intact the initial film is removable only by sand—or grit blasting, or by chemical solution.

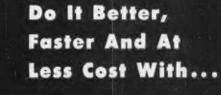
• Corrosion resistance: Solution ceramic coatings are completely protective only against molten metals or viscous glass, against mechanical gas erosion, against high temperatures. In the face of ordinary corrosive vapor and liquid phases, the coatings slow, but do not prevent, chemical attack. However, their ability to be modified or overlaid with other materials enable solution ceramic coatings to qualify as truly protective agents.

Most work so far has been with such refractory metal oxides as zirconia, chromia, magnesia, etc. But certain phosphates, silicates, oxyhalides and even metals will lend themselves to this technique, and two or more can be deposited in separate layers.

The solution ceramic process is available for licensing by industry. Research findings will be made available only to licensees.—Armour Research Foundation, Chicago, Ill.

1480

Crush 9t! Grind 9t Separate 9t

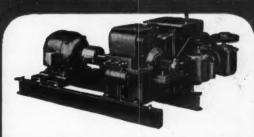


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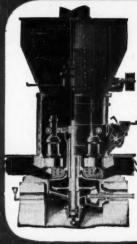
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For heavy duty crushing or grinding of virtually any mineral or chemical — Williams builds them to do a complete job in one operation! Primary and secondary crushers are unnecessary — extra foundations, conveyors, other equipment are eliminated! You can save up to 75% on initial investment — up to 50% on grinding costs with the right Williams Hammer Mill!



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For cleaner, safer dustless grinding of dry materials—or non-clogging, accurate grinding of wet, sticky or greasy materials—to finenesses of 100 to 325 mesh. Combines the advantages of a hammer mill with closed-circuit screw-type feed. No separators, fans or cyclones required. Available with steam or water jackets. Low investment—inexpensive to install and operate.



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For accurate, uniform pulverizing or blending. Instantly adjustable to finenesses down to 400 mesh, even micron sizes. Dries and grinds simultaneously. Automatic, self-adjusting feed. Many other exclusive engineering and construction features. Williams Roller Mills have set new standards for product quality, output and economy.

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OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



Universal Pigments

Work with both latex and alkyd based paints.

Fifty tubes of colorants plus alkyd and latex tinting bases (twowhite and neutral-for each) are all a dealer needs to furnish latex finishes, alkyd flats and alkyd enamels in 300 decorator colors.

The dealer merely determines the amounts and kinds of pigment needed for a particular shade (from color chip rack), squeezes the specified tube or tubes into the base material (white or neutral-alkyd or latex), and gets complete color dispersion in a few minutes stirring (see cut). None of the 300 colors, called Maestro Colors, requires more than two 4-oz, tubes of the primary(50)colorants for each gallon of paint. White tinting base is used for 185 of the colors; neutral for 115.

Special wetting agents enable the universal pigments and tinting bases to provide instant color dispersion in each paint line.-Pittsburgh Plate Glass Co., Pittsburgh 22, Pa.

For More Information . . .



about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Product Briefs.

Lighter colored plasticizers-specifications reduced by one-half-are available now. Dioctyl phthalate is down from 60 to 25 Hazen; dicapryl phthalate is lowered from 100 to 50 Hazen. They'll be especially useful to manufacturers of transparent vinyl sheeting and tubing.-Barrett Div., Allied Chemical & Dye Corp., New York 6, N. Y.

Super-heat proof titanium alloy may be key to more efficient gas turbines. A test turbine with critical parts made of Kentanium, a sintered titanium carbide, endured runs totaling 100 hr. at 1,850-1,900 F. and 30,000 rpm. Alloy's big drawback: it's too brittle as yet for practical use.-Kennametal, Inc., Latrobe, Pa. 150C

Polymeric latices, blended with synthetic resins in textile finishing. improve the fabric's wearing qualities without detracting from the wrinkle resistance and shrinkage control imparted by resins alone. Hycar 1561, a butadieneacrylonitrile latex, and Hycar 4501, a polyacrylic ester, are the most effective modifiers to date.-B. F. Goodrich Chemical Co., Cleveland, Ohio.

Plastic laminate made with glass cloth and three different resinsmaleic alkyd, triallyl cyanurate and a diallyl bicycloheptane dicarboxylate-withstands 30,200 psi. after being heated at 500 F. for eight days. - Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn. 150E

Treatment of hypertension is the forte of reserpine, an alkaloid derived from the Rauwolfia shrub. Trade-named Serfin, it has mild side reactions compared to other hypotensive agents.-Parke, Davis & Co., Detroit 32, Mich. 150F

Rubber softener and tackifier, methylbenzyl ether, is available in quantity now. Its structure indicates high solvency for synthetic resins at high temperatures; it may also be a useful solvent for countercurrent extraction of pharmaceuticals. Price: 28¢ a lb. (tank car).-Carbide and Carbon Chemicals Co., New York 17, N. Y.

Acrylic-type binder for glass mats and molding preforms, Binder P-812, forms hard, tightly adhesive, colorless polymers that resist discoloration at usual drying and curing temperatures (450 F. for 5 min.). Insoluble in styrene and other organic solvents and flow-resistant at high temperatures, P-812 glass fiber binder will not wash out during molding.-Rohm and Haas Co., Philadelphia 5, Pa. 150H

Diatomic iodine destroyed polio virus in one minute in recent vitro experiments. This and other work points to the diatomic form as having a broader antibacterial spectrum than any known antibiotic, and "capable of killing or inactivating most commonly observed disease-producing organisms."-Philadelphia College of Pharmacy and Science, Philadelphia, Pa.

Infiltrase speeds spread through the tissues of solutions, drugs or anesthetics administered subcutaneously or intramascularly. Two results: quicker drug action and less local swelling and pain. A mucous enzyme, Infiltrase hydrolyzes hyaluronic acid, the gel which serves as "cement" in the ground substance of connective tissue. - Armour Labs, Chicago 11. III. 1501

An all-purpose grease for automotive, industry, home and farm use is Esso Multi-Purpose Grease H. Possessing a unique fibrous or stringy structure, Esso H keeps dirt and water out of bearings, water pumps, etc. and clings to the part lubricated.-Standard Oil Development Co., New York 19, N. Y. 150K



METALLIC SODIUM... easy to handle

Production men are learning that Sodium can be handled on a commercial scale, using the same degree of care and caution demanded by most chemicals. As a result, more and more research and development ideas for the use of Sodium as a reaction tool are being put into plant operation.

In 1953, a quarter of a billion pounds of Sodium Metal were produced for industrial consumption: 137 million pounds went into Tetraethyl Lead; 40-50 million for Fatty Alcohols; about 45 million into Sodium Cyanide; 7-10 million into Sodium Peroxide; about 4 million into Sodium Hydride Descaling of steel; and 4 million for insecticides, dyes, drugs, alkoxide preparation, specialty chemicals, and a number of miscellaneous uses.

Sodium is supplied in tank cars, in seel drums (bricks

or solid cast) or small brick in 20 lb. pails. It may be employed as a molten liquid, as bricks, as a dispersion in an inert hydrocarbon or as a coating on free flowing inert solid particles. These last two forms, developed by our research division, are broadening the industrial uses for this versatile metal.

U.S.I. offers complete assistance to research, development and production staffs. We will help you to prepare dispersions and powders and to handle all forms safely. We will aid you on sodium chemistry and in training operating personnel. We will advise on equipment requirements. Booklets are available on all technical phases.

Let us show you how to use Metallic Sodium in your plant.

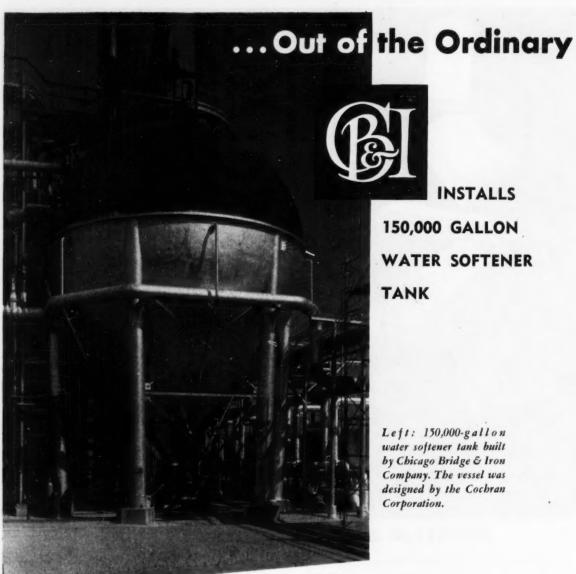


Metallic Sodium is manufactured by National Distillers Chemical Co.

DUSTRIAL CHEMICALS CO.

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INSTALLS 150,000 GALLON WATER SOFTENER TANK

Left: 150,000-gallon water softener tank built by Chicago Bridge & Iron Company. The vessel was designed by the Cochran Corporation.

• If you are in need of a special steel plate structure—something out of the ordinary like the 150,000 gallon water softener tank shown above-have Chicago Bridge & Iron Company build it. Pioneers and one of the world's largest builders of standard and special steel plate structures and storage tanks, CB&I is equipped to fabricate and erect steel plate structures to solve whatever special storage problems your products or supplies may present. We also have an experienced engineering department

that will be happy to help solve your design problems.

CB&I regularly builds flat bottom storage tanks, elevated water tanks, Horton-spheres, Hortonspheroids, Horton Floating Roofs, and storage tanks of aluminum or stainless steel. We can also furnish carbon steel structures, clad or lined with corro-

sion-resistant metals.

Write our nearest office for estimates or quotations on any type of welded steel plate structure your operation may require. There is no obligation on your part.

Pittsburgh 19 Salt Lake City 4 San Francisco 4 Seattle 1 Tulsa 3

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Take a closer look at what's required to make **High Pressure Tubing** to handle ANUFACTURE 30,000 1,000 OIL REFINERY PRESSURE 5,000 10,000 Pressures of 30,000 psi are accepted industrial practice today. They are not only representative of the advances in alloy tubing technology and manufacture, but also of the tremendous strides taken by the industries in which these elevated pressures are everyday working practice.

As pressures advance so must manufacturing techniques. For example, B&W was called upon recently to manufacture a special alloy tubing for polyethylene equipment based on Croloy 12 (AISI 410), to prevent product contamination. Special manufacturing and inspection techniques were involved in the production of the tubing which was cold finished to size. It was then heat-treated to obtain 100,000 psi yield strength, which could have been considerably higher except for the fact that toughness was desired to meet the dynamic service stresses encountered in operation. A sample of the tubing then was tested to 80,000 psi and, in order to force rupture at this pressure it was necessary to remove half of the wall thickness by machining. This destructive testing was made to insure satisfactory working conditions at pressures of 30,000 psi.

This example, while fulfilling the needs of a specific purpose, serves also to indicate the scope of techniques and facilities you'll find at B&W. Today, with laboratory testing of alloy tubing reaching 200,000 psi, the experience and knowledge of those called upon to make a test a working reality are of prime importance. You'll find both at B&W. Call on Mr. Tubes any time to help you meet your needs—standard as well as special.

THE BABCOCK & WILCOX COMPANY TUBULAR PRODUCTS DIVISION

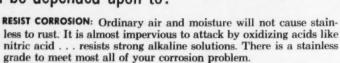
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PREVENT CONTAMINATION: Stainless eliminates rust from entering process materials. And its inert characteristics minimize metallic ions or deterioration residue in the product.

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PROVIDE GREAT STRUCTURAL STRENGTH: Stainless is approximately 50% stronger than ordinary mild steel.

RESIST WEAR AND ABRASION: Because of the alloy content of stainless steels, mixers, chutes and other process equipment made from them will outlast many times those of other metals.

ALLOW COMPLEX FABRICATION: Stainless can be cut, bent, drawn, welded, machined, forged, spun, riveted, cast - fabricated by all the common metalworking processes.

So when you are considering the installation of new process equipment, or the modification of existing facilities, be sure and weigh the advantages of stainless. For practical, down-to-earth help, call Crucible.



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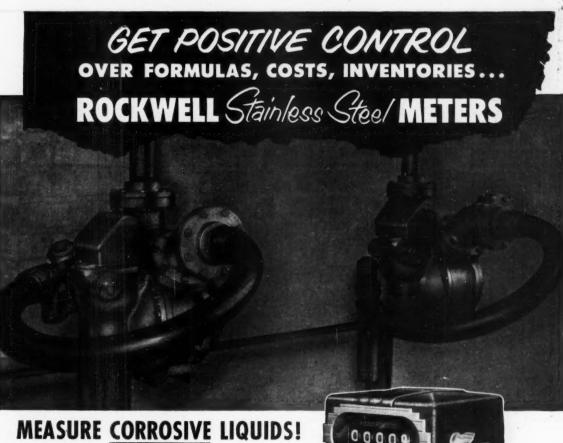
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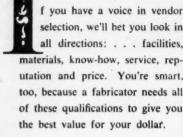




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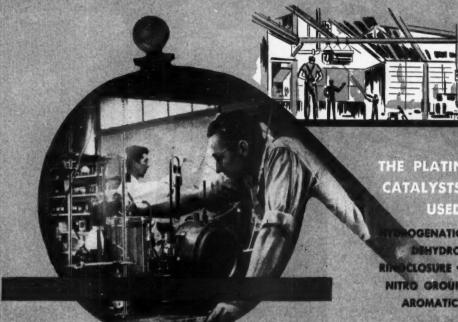
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CATALYSTS ARE NOW
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Recovers Fines in Micron Ranges

Now the famous Sturtevant Whirlwind Air Separator, so widely used throughout industry for fast recovery of fines, has been specially designed to "pick-off" classified materials such as pigments, limestone fillers, plastics, oyster shells, etc., in micron sizes.

These highly efficient air separators select a continuously uniform product of desired fineness. Used in a closed circuit with grinding mills, they increase production, cut power costs.

Large feed opening, rugged construction, ease of adjustment, low power consumption assure economy of operation and minimum upkeep. Write for further information.

STURTEVANT MILL COMPANY

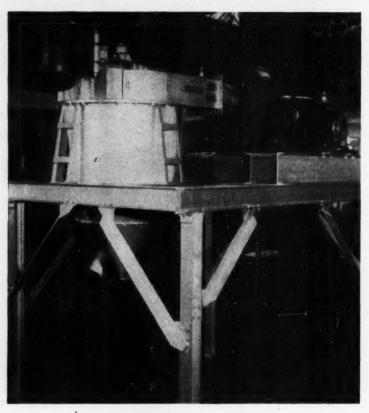
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OTHER STURTEVANT EQUIPMENT



MICRONIZER & GRINDING MACHINE

A fluid jet grinding machine, the Sturtevant Micronizer speeds reduction of materials to low micron sizes. These jet mills are especially applicable in fields where a particle size in microns is desired.

Sturtevant Micronizer grinding machines are available in many sizes and capacities.



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For medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operate in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.



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For granulation, coarse or fine, hard or soft materials. Automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8 x 5 to 38 x 20. The standard for abrasives.



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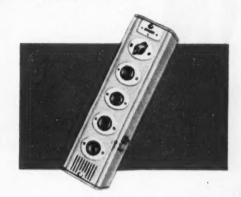
- Offers automatic control integrated with your process.
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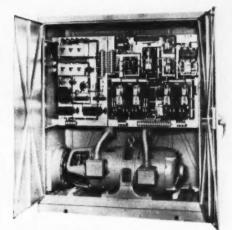
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A fertilizer manufacturer purchased two LaBour Type G pumps eight years ago. He has bought \$184.08 worth of repair parts since. That's \$11.50 per pump per year less than a dollar a month!

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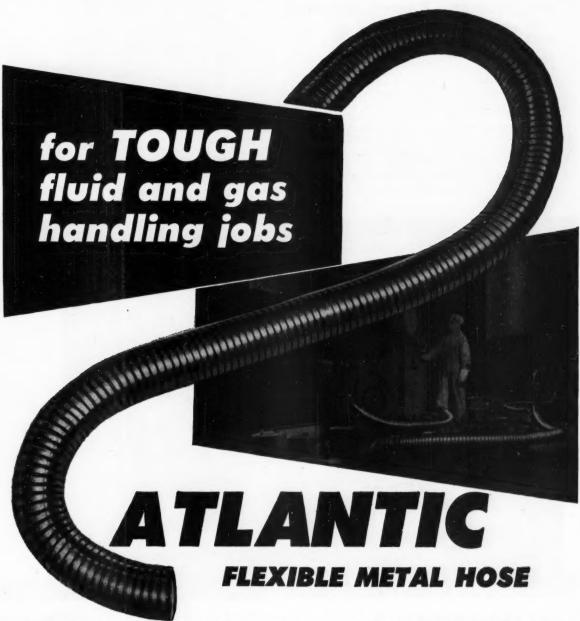
Check your own records to see what pump repairs have cost. You can easily find what replacement parts have been purchased, and estimate the cost of labor and downtime they involve.

If you have LaBour Type G on the job, you'll find costs mighty low. If you haven't been buying LaBour, get the facts together and show them to your P.A.

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Write for Chemical and Process Industries Bulletin 20D.

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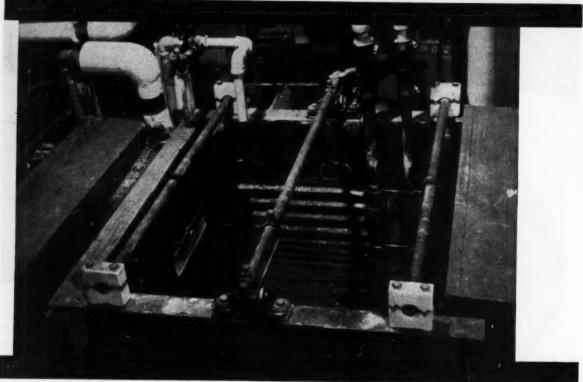
CHEMICAL ENGINEERING—December 1954

new Wyandotte Research Laboratory uses PLATECOILS

to prevent coil-itis *

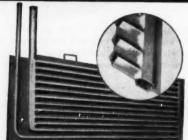
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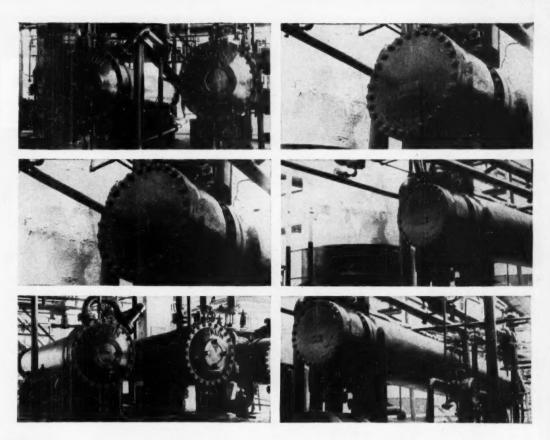


Bulletin P61 shows how Platecoils are replacing pipe coils at a savings throughout industry. Send today for your copy.



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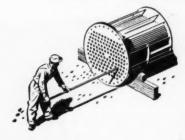
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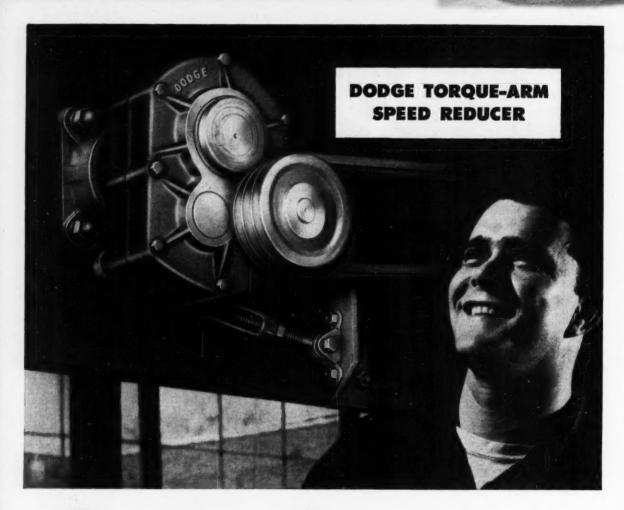
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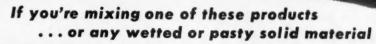
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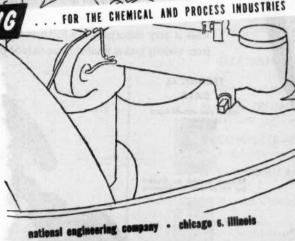
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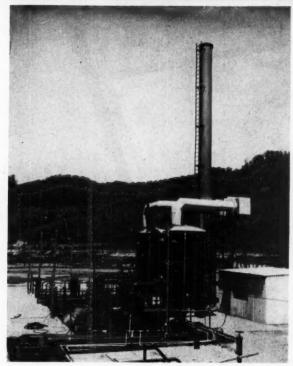
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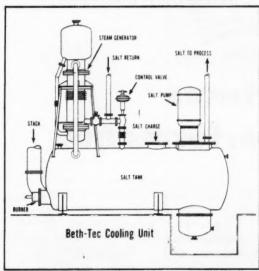


DIAGRAM OF TYPICAL BETH-TEC SYSTEM FOR COOLING APPLICATION,

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- EASE OF INSTALLATION—Constructed in several large sections for easy installation with minimum erection costs.
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Thermal efficiency is good.

Beth-Tec systems can be constructed from standard components to meet special requirements such as severe process duties, heat removal from reaction vessels, special instrumentation, etc.

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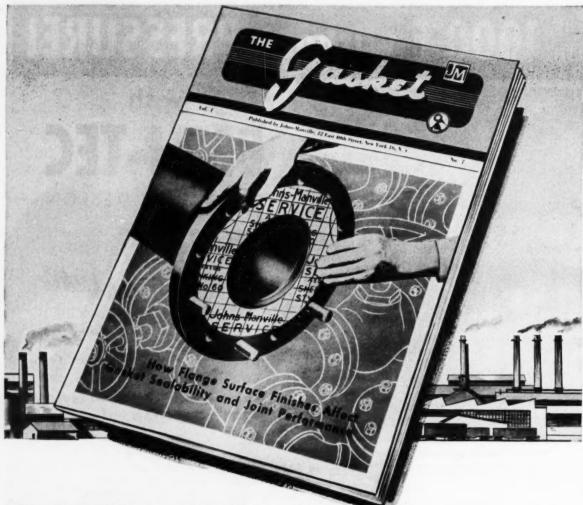


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Blaw-Knox designs and builds both custom and packaged units. For investigations including more highly involved processes, pilot plants are built by specifications determined by a study of the requirements for commercial production.

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Autoclave—electric strip heated ½ gallon x 5000 psi

Pilot Plant for general purpose processing—15 gallon working capacity.



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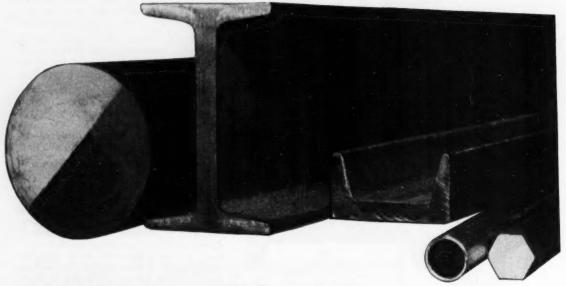
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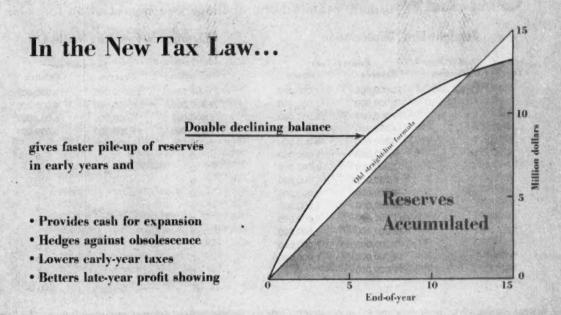


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Depreciation Dons a New Look

Important new depreciation formulas that allow faster write-offs in the early years of a plant's useful life are sure to swell industry's reserves and provide extra cash for more expansion

WILLIAM H. CHARTENER and EDWARD T. THOMPSON

Have you ever worked long and hard on an expansion project only to have it unceremoniously cancelled because your company couldn't get a rapid amortization certificate from the government? Because the early tax burden was likely to be more than the early post-tax profits could support? Because the danger of early obsolescnce was too great to risk conventional straight-line depreciation.

BILL CHARTENER, feature writer for CE's Chemical Economics Dept., operates out of the McGraw-Hill Dept. of Economics. Ed Thompson is CE's Economics Editor.

The chances of this happening again are now much less due to the more liberal depreciation code included in the omnibus tax revision passed by Congress earlier this year. Your company has more freedom in handling depreciation than it's had in 20 years. Through its effect on taxes, profits and available cash, depreciation allowance will probably have a decisive impact on your company's operations in the months ahead.

So it's essential for you, as an engineer, to know just what depreciation formulas are now legal and what each can accomplish in the way of bigger reserves and lower taxes.

Take Your Pick

There are now seven major ways to figure depreciation allowances, some old, some brand new.

• Straight-line depreciation over the useful life of a plant or piece of equipment, the standard method ordinarily required since the early 1930's. Equal amounts are charged off each year.

• Double declining balance method in which a fixed percentage, but smaller dollar amount of the unamortized balance is charged off each year. Because up to twice the straight-line rate is allowed, you can write-off twothirds of the total investment in the first half of useful life. This is con-

Old Law usually required one of these two depreciation formulas:

Straight-Line Depreciation

Emergency Fast Tax Write-Off

	End-of-Year				End-of-Year	
Year	Deduction	Reserve	Balance	Deduction	Reserve	Balance
1	\$1,000,000	\$1,000,000	\$14,000,000	\$3,000,000	\$3,000,000	\$12,000,000
2	**	2,000,000	13,000,000	3,000,000	6,000,000	9,000,000
3	**	3,000,000	12,000,000	3,000,000	9,000,000	6,000,000
4	**	4,000,000	11,000,000	3,000,000	12,000,000	3,000,000
5	**	5,000,000	10,000,000	3,000,000	15,000,000	0
6	**	6,000,000	9,000,000	0	**	0
7	* **	7,000,000	8,000,000	0	**	0
8	**	8,000,000	7,000,000	0	**	0 -
9	**	9,000,000	6,000,000	0	**	0
10	**	10,000,000	5,000,000	0	**	0
11	**	11,000,000	4,000,000	0	**	0
12	**	12,000,000	3,000,000	0	**	0
13 .	**	13,000,000	2,000,000	0	**	0
14	**	14,000,000	1,000,000	0	**	0
15	**	15,000,000	0	0	**	0

sidered to be the most important change in the new law.

• Combination of declining balance during the early years of useful life and straight-line in later years.

• Sum of the years' digits method, which is similar to declining balance, but easier to figure.

• Fast amortization, authorized during the Korean War on certain defense installations only. It recovers full plant cost in 60 months and is the fastest way for long-lived assets.

• Unit of production method, also allowed under the old law, apportions depreciation over the barrels of oil or tons of ore produced. It is largely limited to extractive industries.

 Any other formula that doesn't give faster write-off at any point during the first two-thirds of an asset's useful life than the double rate declining balance method.

Why It's Important

What makes treatment of depreciation in tax laws of such consequence to business?

In computing net income for tax purposes the law permits (and has since 1909) a reasonable allowance for the exhaustion, wear and tear and obsolescence of property used in trade or business, or held for the production of income. Depreciation charges are deductible from a firm's taxable income and thus reduce its tax bill for the year in question. The method of calculating depreciation allowances can also affect total tax payments and profit of a business.

And even without tax inducement, depreciation allowance would have to enter the accounts of any well-managed company because it constitues a systematic way of recovering the original cost of a capital item. Reckoning production costs without making proper charges for the using up of equipment and buildings is an excellent method of giving a business away.

Depreciation is also extremely important in financing business. Money set aside to recover the cost of an old piece of equipment can be used to buy a new replacement. Ordinarily, however, depreciation allowances can't be traced precisely to expenditure on an identical new piece. Rather, the annual allowance represents an addition to the funds a company has available for modernization, expansion, debt reduction, outside investment and even payment of dividends.

For a growing firm, depreciation reserves are almost never big enough to cover the year's replacement and expansion expenditures. Additional funds must come from retained earnings and borrowed capital. But the reserve is a rapidly mounting source of growth funds.

And it's big money. Corporate depreciation allowances rose from \$4.2 billion in 1946 to \$7.9 billion in 1950 and to \$11.8 billion last year. With the combined effects of 60-month amortization for defense facilities and the liberal formulas allowed by the new tax law, corporate funds derived from depreciation will probably hit \$16.5 billion next year and \$19 billion in 1957.

How to Figure

Suppose you are planning to build a \$15 million ammonia-urea plant with an estimated useful life of 15 years. Here (and in the tables above) are the basic ways you can figure depreciation under the new law:

• Straight-line: Find the annual rate by dividing 100% by the number of years of useful life (100%/15 = 6\frac{2}{3}%). Multiply this rate by the original cost (6\frac{2}{3} \times \frac{1}{3}5,000,000 = \frac{1}{3},000,000). Make this allowance each year until the 15 years are up. The unamortized value of the plant decreases by the same amount each

an estimated useful life of 15 years, here's how you could figure depreciation.

New Law adds these two liberal methods for faster amortization:

Double Rate Declining Balance

Sum of the Years' Digits

	End-of-Year				End-of-Year	
Year	Deduction	Reserve	Balance	Deduction	Reserve	Balance
1	\$2,000,000	\$2,000,000	\$13,000,000	\$1,875,000	\$1,875,000	\$13,125,000
2	1,733,333	3,733,333	11,266,667	1,750,000	3,625,000	11,375,000
3	1,502,222	5,235,555	9,764,445	1,625,000	5,250,000	9,750,000
4	1,301,926	6,537,481	8,462,519	1,500,000	6,750,000	8,250,000
5	1,128,336	7,665,817	7,334,183	1,375,000	8,125,000	6,875,000
6	977,891	8,643,708	6,356,292	1,250,000	9,375,000	5,625,000
7	847,506	9,491,214	5,508,786	1,125,000	10,500,000	4,500,000
8	734,505	10,225,719	4,774,281	1,000,000	11,500,000	3,500,000
9	636,571	10,862,290	4,137,710	875,000	12,375,000	2,625,000
10	551,695	11,413,985	3,586,015	750,000	13,125,000	1,875,000
11	478,135	11,892,120	3,107,880	625,000	13,750,000	1,250,000
12	414,384	12,306,504	2,693,496	500,000	14,250,000	750,000
13	359,133	12,665,637	2,334,363	375,000	14,625,000	375,000
14	311,248	12,976,885	2,023,115	250,000	14,875,000	125,000
15	269,749	13,246,634	1,753,366	125,000	15,000,000	0

year and the plant is fully depreciated at the end of 15 years.

- · Double declining balance: The rate permitted on the declining balance is up to twice the straight-line rate. In this case you would deduct 131% of the unamortized value each year (first year, $13\frac{1}{2}\% \times $15.000.000$ = \$2,000,000; second year, $13\frac{1}{2}\% \times$ \$13,000,000 = \$1,733,333; third year, $13\frac{1}{3}\% \times \$11,266,667 = \$1,$ 502,222; etc.). The annual allowance becomes smaller each year and the unamortized value decreases by progressively smaller amounts. About 11.7% of the original cost is still not written off at the end of 15 years, but note that approximately two-thirds of the original cost has been amortized in the first half of the plant's useful
- Combination of declining balance and straight-line: To avert the problem of an unamortized residual (10-13%) at the end of the plant's useful life, that may exceed the salvage value, the new law allows you to shift to straight-line depreciation at any time. This permits full write-off (less a realistic salvage value if you want to deduct it from the value of the plant), yet preserves the advantage of faster early-year write-offs. In our example you might want to switch to straight-line

amortization after the eighth year under declining balance. You would take one-seventh of the unamortized balance at that time (\$4,774,281) and charge off this amount (\$682,040) in each of the last seven years.

- Sum of the years' digits: Add the numbers representing the years of useful life (1 + 2 + 3 + ... + 15 =120). The sum is the denominator and the number of useful years remaining is the numerator. The fraction obtained is applied to the original cost each year (first year, 15/120 × \$15,000,000 = \$1,875,000; second year, $14/120 \times \$15,000,000 = \$1,$ 750,000; etc.). The large allowances in the early years are close to those obtained by the declining balance method, but the entire original value is written off under one formula during the period of useful life.
- Fast amortization: If you can obtain a certificate of necessity under the defense program, your plant can be fully amortized over five years, regardless of its actual useful life. In the case of our ammonia plant, one-fifth of the original cost, or \$3,000,000, could be charged off in each of the first five years and no additional depreciation could be taken subsequently. Note, however, that the certificate need not cover the full amount

of installation, in which case only the certified portion is eligible for rapid write-off.

• Unit of production: Suppose you'd spent \$60,000 in capital costs to drill an oil well that you expect will produce 215,000 bbl. of crude oil during its lifetime. You will receive income as oil is produced and sold, but your operations and sales will probably not be the same each year. In this case you could charge depreciation at the rate of 28¢ per bbl. of oil produced, the entire capital cost being written off when 215,000 bbl. have been taken from the ground. Remember, though, that if your estimate of the amount of oil that can be produced is too high you will never fully depreciate the equipment.

Just two words of caution: The liberalized formulas of the new law may be applied only to equipment installed after Jan. 1, 1954. And the double declining balance method can't be used on assets with useful lives of less than three years because that would allow one-year write-off.

Which Method Is Best?

Each depreciation formula has its advantages and pitfalls. To decide which one to use for any particular

project, several economic factors must be considered.

· Recovery of investment. All , the rapid depreciation formulas enable you to recover most of the cost of plants or equipment earlier than the straight-line method. Under both double rate declining balance and sum of the years' digits you get back at least two-thirds of the total cost in the first half of useful life. And fast recovery of investment speeds up availability of money for additional expansion and modernization, or just for gaining interest on the money.

· Actual loss of value. Advocates of accelerated amortization argue that most equipment loses value faster during the early years of its life than during the later years, mostly through faster obsolescence and more intensive use. Depreciation allowances, they insist, should reflect the actual loss of value of a capital item. And the new fast depreciation methods seem to do this better than conventional straightline deductions.

Taxes Play a Big Part

The effects of depreciation formulas on taxes depend on just how your profits and tax rate change over the depreciation period. If the corporate tax rate doesn't change, and if you make a profit each year (after depreciation charges), then your total tax bill over the years will be exactly the same no matter how depreciation is figured. However, it may be to your advantage to put off payment of taxes as long as possible. Accelerated depreciation, by cutting down taxable income in the early years, postpones the years of heavy income tax payments.

If you expect the tax rate to fall in the next few years, you'll be better off (assuming you're right) to hold off your heavy tax liabilities until the lower rate actually comes in. The more you can cut down taxable income in high-rate years, the less total

tax you'll pay.

But if tax rates rise, accelerated depreciation will stick you with a higher total tax bill than the straight-line formula. You will have used up the bulk of your allowable deductions in low-rate years and no matter how you apportion your depreciation allowances, you can use the total only once.

If you fear you'll make money only in the early years, you may gain an important advantage from an accelerated formula. Your tax liabilities are reduced to the minimum in profitable years by high depreciation allowances; and in years of little or no profit, deductions for tax purposes do you no good anyway. In this situation you won't have to make up in higher taxes later what you gain from taking heavier deductions in the profitable

However, if your bad years happen to be, say, the second and third instead of the tenth and eleventh, the situation is completely reversed. Your big early-year deductions by an accelerated formula will be wasted.

Another way fast depreciation can save taxes is through the favorable tax rate on capital gains. Suppose you sell your equipment well before its useful life is over. You may be able to sell it for more than its unamortized value, especially if you've been using a fast write-off formula. Your profit over unamortized value is taxable as capital gain at only 25%, but the amount you've saved through fast depreciation allowances was at the income tax rate of 52%.

Don't Overlook These Effects

· On financial statements. Depreciation charges on a really big investment can swing a lot of weight in your income statement.

With accelerated formulas, heavy allowances in the first two or three years may knock a big chunk out of reported profits. The effect in later years, however, would be to improve profit showing. If you expect poor years later on, fast depreciation prevents these charges from being a continual drag. A straight-line formula, with equal annual deductions, makes the effect of depreciation on earnings the same in all years.

· On bookkeeping. Straight-line depreciation is far easier to use from an accounting standpoint than a declining balance or sum of digits method. So unléss a good deal of money is involved, it probably won't pay you to get involved with fancy mathematics.

Declining balance depreciation was also available under the old law in

certain circumstances. But the allowable rate was generally only 11 times the normal straight-line rate. This served to reduce its attractiveness and it wasn't used to any great extent. Liberalization to the double rate is expected to make the method far more popular because the gain in most cases will offset the more complicated bookkeeping involved.

The advantage of declining balance also drops when equipment has a really long useful life. On a building that depreciates over 33 years, for instance, a double rate would mean only 6% in the first year compared with 3% allowed by straight-line. The difference in accumulated reserves would soon be insignificant. Thus fast depreciation is of advantage primarily to firms making a large investment in plant and equipment relative to labor and materials.

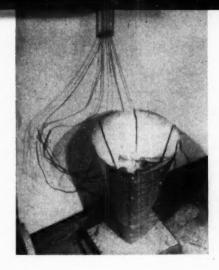
· On old methods. The new law specifically states that its new provisions do not limit any methods previously available. And taxpayers are clearly given the right to use different depreciation formulas for different properties.

In addition, the new law makes a number of important technical and interpretive revisions that add up to a better break for business. For example, a depreciation schedule agreed upon in writing cannot be changed arbitrarily by the Internal Revenue Service.

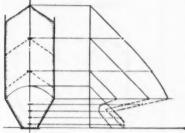
· On capital spending. By dangling the attraction of faster recovery of investment and postponement of taxes, if not permanent savings, the new depreciation policy provides incentives to spend more on new plants and equipment. This will mean larger and more efficient plants for industry in general and more orders for the construction and machinery industries. All of which points toward greater business activity in the immediate future and a more productive economy in future years.

For the individual company, though, there's a possibility that fast depreciation will offer temptations to make investments that might not be considered wise under a straight-line policy. The merits of the investment itself are still the most important consideration, not which depreciation

formula you can use.



Research on hoppers points to better understanding of solids flow, and therefore to . . .



Better Design for Bulk Handling

Work described here, though not yet complete, can even now help avoid troubles with bins and hoppers. Eventually, it should enable solids handling designs to cut capital costs, assure better results.

ANDREW W. JENIKE

With the rapid development of automatic operation of processes in recent years it is becoming ever more important to make sure that all links in the chain of automatic operation will function smoothly. Such a link is the flow of solids through bins, hoppers, spouts and feeders. Any arching, hanging up or sticking of the material may disrupt the operation of an automatic system. But past practice in the design of bulk solids handling equipment of these sorts has brought about many disappointments. The only way to predict how material will flow through a bin has been to make a full-scale test, or rely on repeating a successful design for the same material.

For a number of years the author has been working toward the development of a quantitative method for designing such equipment. He has developed a theory of bulk solids flow and determined a property of bulk solids, called the flow-factor, which governs the flow, together with experimental methods for measuring the flow-factor. Finally, he has derived certain flow formulas in general form, although this work is still incomplete and some of the coefficients are still to be evaluated.

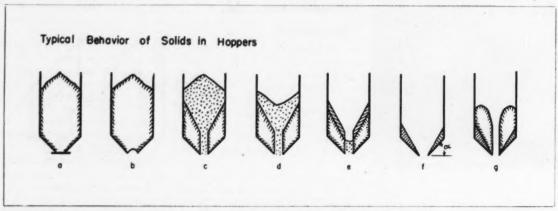
In the course of this work the flow theory has helped to explain many of the peculiarities of solids flow in bins and hoppers and has shown why some arrangements give good results, while others do not. Thus, many tangible advantages are already available from this approach, even though the mathematical aspects of the theory are not yet complete. Once this method has been fully developed, it should permit the handling system of a plant to be designed to a predetermined flow-factor. It should be possible to study the effect of possible changes in either character of the solid, or the method of handling. Considering the economy of the design, we should be able to achieve a certain objective which might be either unfailing flow at all times or, if that were not justified, occasionally assisted flow. In any event, it should be possible to save capital cost by preventing over-design and, at the same time, to keep operating costs within planned limits by assuring smooth flow of material.

Development of the theory of solids flow has come from the observation of industrial systems, as well as tests on model bins. The theory can be summarized as follows: A bulk solid undergoes compaction under pressure in a bin. There are three sources of such pressure: weight of the overlying material, impact, and vibration. Under pressure the solid builds up strength. When the hopper gate is opened or the feeder started, material immediately above the gate or feeder is removed. Hence, conditions of support of the mass within the bin are changed and the stresses within the mass are redistributed. An arching effect develops within the material. If the stresses in the arch are higher than the strength which the material has built up, then the arch will break down and the material will flow. If the stresses are lower, material will not flow and an obstruction has developed.

Mechanics of Flow

Fig. 1 shows the typical behavior of a bulk solid in a bin. The bin is composed of a vertical portion and a sloping portion or hopper. The outlet of the bin is at the bottom of the hopper and is provided with a gate

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INFINITE VARIETY of flow conditions can occur in discharge of a bin, but the sequence shown in (a) to (f) is typical-(Fig. 1)

or feeder. Initially, the bin gate is closed (sketch a) and the bin has been filled with material. Material was loose at the time of filling but it has compacted and built up strength under its own weight and under the impact of the falling particles. In (b) the gate has been opened. Material in the shape of a dome is deprived of support, it fails and drops out of the bin. With a feeder instead of a gate, the same thing happens except that material is removed more gradually. Hence, a redistribution of pressure takes place. An arching or doming effect develops in the vicinity of the opening. Now either of two things can happen: if pressure in the arching material does not exceed its strength, there is no flow. An obstruction called doming has developed. If pressure within the dome exceeds the strength of the material, the dome disintegrates and material begins to flow. The process of disintegration proceeds upward through the mass. The flowing core is in the shape of a vertical funnel (sketch c) widening out toward the top of the filling.

Material flows into the funnel along concentric cones. Material at the center of the bin flows out first. As a result, the top of the filling gradually flattens out and then forms a depression at the center, as in (d). As the level of the flowing solid drops, the previously stable material on the outside is uncovered and deprived of supporting pressure from the inside. A layer fails due to wedging action, as in (e), and slips down the funnel. This may occur again and again until either all material has emptied out or, if the slope of the hopper is not sufficiently steep, until material has formed a stable crater (sketch f). The slope angle α of the crater is usually close to $45^{\circ} + \phi/2$, where ϕ is the angle of internal friction of the material. α is usually between 60° and 65° .

Alternatively, as layer after layer fails and slips down the funnel, stronger and more compacted material may emerge at the top. This material may refuse to flow. The core may empty out and an obstruction develop, as at (g). This is called funneling. As a result of the wedging action, material contracts toward the center of the bin and a gap can often be seen between material and bin wall.

In bins with very steep hoppers, the core funnels out within the hopper to include all the material in the bin, that is, the whole mass moves down simultaneously.

It should be noted that when material disintegrates and flows, it loses its strength. If that material becomes stationary again, it recompacts under the pressure prevailing at the new point and gains the strength corresponding to the new pressure. The sequence of flow, as it has just been described, is only one of an infinite variety that can and does take place in the flow of material through a bin. Seldom is a bin filled completely and then emptied out completely. Usually some material is drawn out of the bin and other material added, so that the level fluctuates up and down. However, the sequence has little influence on the character of the described obstructions.

The strength which the material develops at any particular point of a bin is a function of the largest pressure at that point. A mathematically derived general formula for pressure in bulk solids in a bin does not seem possible to the writer for several reasons. Therefore, it is necessary to proceed on an empirical basis.

The pressures that will now be considered are those occurring prior to the opening of the bin gate or the starting of the feeder. They may be due to: (1) the weight of material, called static pressure; (2) the impact of falling material, referred to as impact pressure; and (3) vibration of the bin, or vibrational pressure.

Static Pressure

Static pressure varies throughout the mass of material not only with elevation but also with lateral position in a bin and with direction. The ratio v/w, called unit pressure or head (vertical pressure v along the centerline of a bin per unit weight w of the material) is chosen as being representative of the pressure pattern in a bin. Unit pressure is a linear quantity, measured in feet.

Tests of pressure v were made with sand in a model conical hopper, with pressure gages set at several depths for the test. A gage comprises a pressure capsule with a copper tube leading out of it and connecting to a plastic tube. The gage is filled with colored water. Under the pressure of the material, the diaphragms of the capsule are compressed and the reduction in volume sends the level of liquid up in the plastic tube. The difference of levels is a measure of the pressure on the diaphragms.

Results of the tests are shown in Fig. 2 which is a plot

of the ratio v/w against height for six levels of material in the hopper. We see that unit pressure, as the point of measurement moves downward, first increases linearly as it would in a liquid. At some height of the bin the pressure reaches a maximum, but then it falls off to zero at the apex. In general, the unit pressure in a bulk solid follows one of a family of curves such as the solid curve in Fig. 2, or one of the dotted curves shown extending to the right of it.

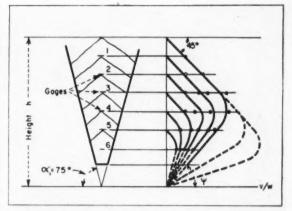
Consider that layers of material are added to an empty hopper without impact. At a given point pressure increases as the material compacts and subsides. In an unlimited and level mass of material, each layer subsides evenly and the vertical pressure increases hydrostatically with the depth of the material. However, in a hopper the walls produce a deviation from this pattern. At the walls, the subsidance is either restricted or prevented altogether. Therefore, pressure in a layer is higher at the walls than at the center of the hopper. In other words, the walls support more than their proportional share of the weight of each layer and pressure in the material builds up at a rate less than hydrostatic. The influence of the walls becomes pronounced toward the apex of the hopper and the pressure curve turns down toward zero at the apex.

The greater the deviation of unit pressure from hydrostatic, the less is the compacting pressure in a material and the better is the flow. The deviation is measured by angle ψ in Fig. 2. It is evident that a large value of ψ is beneficial, because it corresponds to a low unit pressure v/w. The value of angle ψ depends on the shape and size of the hopper and on the bulk solid.

When the slope angle α_s of the hopper walls is small enough to permit the formation of a stable crater (see Fig. 1f), and the dead material of the crater is left undisturbed to settle and compact, then the crater can be considered as a natural hopper. For such a crater the slope angle α is about 60° to 65°. The angle ψ for a fresh crater is considerably less than for a compacted crater, which means that the unit pressure will be higher. This is evidenced by the fact that flow difficulties are common when a bin or pile is first filled. After a few days, how ever, when the crater compacts, these difficulties disappear.

If the hopper slope angle α_1 is more than a certain value, a crater cannot form for lack of sufficient support from the hopper wall. Fines will form a stable crater on a

Presented here and in the following article by C. A. Lee is a wealth of new material on solids flow in bulk handling systems. Our two authors differ somewhat in their theoretical approach, but their paths are roughly parallel and their objectives the same. Dr. Jenike believes that solids pressure must be determined empirically, while Mr. Lee's mathematics has produced a formula which seems to check closely with the Jenike empirical results. Although the work is not yet complete, it can provide useful information now.



MODEL HOPPER tests reveal pressure-height curves that vary with depth of material, differ for various materials—(Fig. 2)

steeper slope, say $\alpha_1 = 45^\circ$, than run-of-mine material, which may require $\alpha_1 = 30^\circ$. Furthermore, experience seems to show that slope angles between that which will form a crater, and 55°, will give a pressure angle ψ which is close to zero, so that the unit pressure should be taken as hydrostatic. This is the case because the hopper opening is always some distance above the apex. With small values of ψ the vertical pressure at the opening will for all practical purposes equal the head of material. Fig. 2 will make this clear. When α_1 is less than about 55° the influence of the hopper walls on the pressure pattern is insufficient to have appreciable affect on the vertical pressure at the center of the hopper.

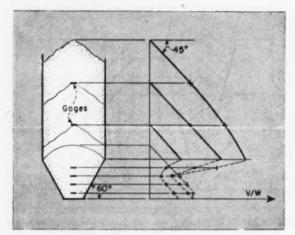
However, as α_1 becomes larger than 55°, the walls have an increasing influence on the pressure and angle ψ in creases, probably reaching a maximum at about 85°. For this value the vertical pressure is least' and flow should be best.

The height of material h in the hopper also affects the pressure angle ψ as Fig. 2 shows. As h increases, ψ is reduced and the pressure increases. But beyond a certain height the reduction of ψ is small, and possibly asymptotic.

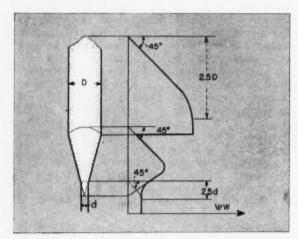
Firm support of the flowing mass from the crater of hopper increases the relative subsidence and thus increases angle ψ . The influence of the degree of settlement of the dead material forming the crater has already been mentioned. Similarly, a rigid hopper is conducive to better flow than a flexible suspension bunker.

The unit weight of a bulk solid increases with the compacting pressure. It is expected that the sharper this increase, the greater will be the relief of pressure at the center of the hopper due to a given relative subsidence; therefore, materials with steep curves of w vs. v are likely to flow better. This difference in flow is likely to be more significant in bins with craters of dead material than in those too steep to form a crater.

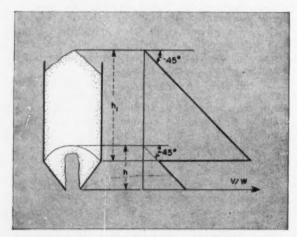
The foregoing has applied to pressure in hoppers. Inmodel bins, tests as well as other evidence show that material in the vertical portion of the bin has practically no influence on the pressure in the lower part of the hopper. Therefore, it does not affect flow of material through the hopper. Fig. 3 shows the results of measure-



MODEL BIN shows pressure drop at bottom of vertical part, small effect of material depth on outlet pressure—(Fig. 3)



IN BINS and spouts, pressure is almost constant below depth of about 2.5 diameters. Note the two pressure peaks—(Fig. 4)



RELATION of bin and hopper heights controls point of peak pressure, determines where doming may occur—(Fig. 5)

ments of the vertical pressure in sand along the centerline of a model bin for three levels of material. We see that at the transition from the vertical portion of the bin to the hopper, pressure drops down abruptly and then picks up again in the hopper, as if there were no material above.

In general, a unit pressure diagram can be constructed as shown in Fig. 4. In the vertical portion of the bin, pressure first increases hydrostatically, then levels off, so that it is practically constant below a depth equal to about 2.5 diameters of the bin. At the transition to the hopper, pressure decreases and then increases hydrostatically in the hopper, reaches a maximum and decreases toward zero at the apex of the hopper. At the transition to the spout, pressure levels off again at a value governed by the diameter of the spout. Below a depth of spout equal to about 2.5 diameters pressure is practically constant. We now have two cross-sections of the bin at which pressure reaches maximum values—one roughly midway of the hopper, the other at the transition from the vertical.

Consider the bin shown in Fig. 5. For simplicity a hydrostatic unit pressure increase is assumed in the hopper. As long as h is larger than h,, the critical condition for doming remains at the outlet of the hopper. For h, larger than h, however, the largest pressure occurs at the transition and it is there that material develops the highest strength. As the gate is opened, it may well happen that material above the gate will fail and disintegrate up to some such height as shown in the figure. Above that height, material domes and remains stable. The stable material around the core now undergoes an intense wedging action and may fail outright, so that the whole mass will flow simultaneously. This is likely to happen in a sufficiently steep hopper.

On the other hand, failure of the wedge may be delayed until some of the material of the core has emptied out, or until the wedge is broken up by prodding or vibration. A troublesome situation now arises. As material flows out, a void is formed inside the bin and when at last the wedge fails, the mass of material drops, picking up speed until the void is filled, and then material is brought to an abrupt halt. The resulting shock compacts the material. The larger the void, the heavier the compaction. This situation often leads to serious obstructions to flow. Or, with fine and fairly dry materials it may lead to heavy aeration of the dropping material, which fluidizes and floods the following equipment.

From the foregoing it is clear that the strength that a solid develops increases as the compacting pressure is increased. Thus, it is of advantage to keep compacting pressure in the material as low as possible. A few methods of doing this will now be described. For simplicity a hydrostatic pressure increase is assumed in the hoppers.

Pressure Breaker—This is essentially a horizontal shelf placed centrally in the hopper and helping to support the material above it, as in Fig. 6. The pressure below the breaker is reduced and so is the compaction of the material, allowing it to flow through a smaller opening, or to a feeder. The pressure breaker has found successful application in the Northwest in domestic heating installations burning sawdust. Other applications have been reported to work successfully. • •

Vertical Partition—In a tall bin one or more partitions can reduce the compacting pressure at the transition from the vertical portion to the hopper. This arrangement is shown in Fig. 7. Without the partitions the unit pressure would follow the dotted hydrostatic line. With the partitions, the effective diameter of the bin is reduced and hence the pressure, since pressure in a vertical bin does not increase beyond a depth of about 2.5 diameters. Furthermore, the maximum value of pressure does not exceed the weight of a layer equal to about 2 diameters.

Horizontal Ledges—Narrow circumferential ledges in the bin can also be used to control the compacting pressure. Each acts as a transition point and so lowers the unit pressure, resulting in a saw-tooth pattern. It is advisable to keep all peaks of pressure below the pressure at the opening of the hopper. In this way, the danger of doming across the funnel is eliminated.

Impact Pressure

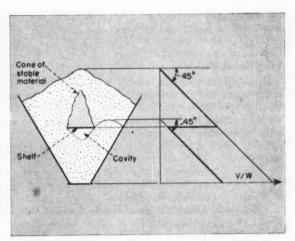
Impact pressure is an important factor in the flow of material in tall bins with steep hoppers, as well as in chutes and spouts. Assuming a feed into a bin at a steady rate Q, striking the top of the filling at speed v, the impact produces a force of F=Q v/g acting on the filling. The force is proportional to the rate of feed and to the striking velocity. If the falling lumps are sufficiently large for air friction to be neglected, we have $v=\sqrt{2 g h}$, and $F=Q\sqrt{2 h/g}$, where h is the height of free fall. To appreciate the order of values, consider an example: Material of unit weight w=100 lb. per cu. ft. falls through a distance of 30 ft. at the rate Q=500 tons per hr. or 277 lb. per min. The force then is $F=277\sqrt{2\times30/32.16}=380$ lb.

Assuming that material strikes an area of 1 sq. ft. of the filling, the impact pressure is 380 lb. per sq. ft., equivalent to the static pressure of a 3.8-ft. high layer of material. Multiplying this result by a factor of, say, 2 to allow for the fact that the peak rate of feed is bound to be higher than the average rate Q, we obtain a pressure equivalent to a layer of 7.6 ft. This is not significant compared with the hydrostatic pressure in a bin ($\psi = 0^{\circ}$), but it shows that, when the opening of a hopper is designed for $\psi > 0^{\circ}$, impact pressure cannot be disregarded.

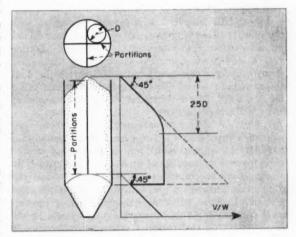
When the hopper is almost empty, material falling the height of the bin may compact at the opening and produce doming. In a steep hopper, impact tends to produce bodily slip of the whole mass down the hopper, with resultant wedging of the mass. Wedging produces lateral pressures which experience shows may be in the range of hydrostatic pressures. Thus impact nullifies the advantage that might be obtained from a steep slope angle α_1 .

This explanation leads to a remedy in the form of horizontal ledges or steps around the hopper. These eliminate the possibility of bodily slip along the walls and thus eliminate wedging. When complete self-clearance is necessary, it is possible that ledges sloping at an angle of 45° to the horizontal may provide sufficient support to the mass and yet assure clearance of the material. A vibrator can be used to loosen sticking particles.

Impact pressure takes on particular significance in chutes and spouts. The largest static pressure in a chute or spout



DISK or CONE reduces pressure above hopper outlet, thus reducing hopper clogging tendencies—(Fig. 6)



VERTICAL PARTITIONS reduce effective bin diameter, lower compacting pressure, assist bin discharge—(Fig. 7)

does not exceed the hydrostatic pressure in a layer of material of a height equal to about two diameters of the spout or chute. This value can easily be exceeded by impact pressure. In order to prevent impact pressure from arising in a spout, it is necessary to avoid bringing material to an abrupt halt within the spout. This can be accomplished by suitably locating gates or feeders. For example, with a gate at the top of the chute, material feeds out and no material is ever stationary within the chute. Or, the spout can always be kept full of material if a gate or preferably a feeder is placed at the bottom of the spout and the velocity of flow is kept under control at all times. When the height of fall is considerable, it is advisable to reduce the impact by breaking the path of flow.

With aerated, fine or flaky materials, impact need not be considered, because air friction adequately controls the velocity of fall. However, without aeration, such material (if allowed to settle before it is fed into a bin or spout) will not completely disintegrate during the fall. Instead, it will fall in lumps and may gain the full velocity of $\sqrt{2} g h$.

Vibrational Pressure

Prolonged vibration of a material leads to the escape of entrapped air and a rearrangement of particles, increasing the density of the material and its strength. In some cases vibration cannot be avoided. But usually the vibration of a bin comes either from supporting the bin from a building structure which is subject to shock and vibration from cranes, vehicles and machinery, or from mounting vibrating screens or crushers directly on the bin. Bins designed for $\psi > 0^{\circ}$ should be structurally insulated from sources of vibration. Otherwise the effect of vibration can only be offset for by allowing a liberal factor of safety. Vibration can be particularly harmful in spouts which operate full of material. Spouts are of small diameter and vibration can easily build up the little strength required to produce doming.

The Flow-Factor

A loose bulk material has no strength, it slips through one's fingers. That same material, compacted, may exhibit definite resistance to compressive, tensile and shearing stresses. How much a material will build up compressive strength under compacting pressure will govern the flowability of the material. This property is, therefore, called the flow-factor. The flow-factor of a bulk solid is expressed in the following function:

 $f_o/w = F(v/w)$

In this expression fo is the unconfined compressive strength[®] of a material under a given compacting pressure v. In general the pressure at a point in a bulk solid depends on the direction in which it is measured and the compacting pressure in question is the largest principal pressure. Like the unit compacting pressure we have already considered, the unit strength f./w is a linear dimension, and is measured in feet. It can be measured on a transverse shear testing machine in which the material is first compacted under a known pressure v, then sheared against itself or against a sample of bin wall material under a lesser test pressure p. Repeating the test under another test pressure gives a second point for plotting a straight line on a graph of test pressure vs. peak shearing stress. The slope of this line gives the angle of internal friction ø, while the intercept on the shearing stress axis gives the value of the effective cohesion c. From these values fe is calculated^{a, 7} from the expression $f_c = 2c \tan (45^{\circ} + \phi/2)$.

Flow Formulas

To insure flow from hoppers the author in an earlier publication' derived two expressions for hopper dimensions: (1) one for the width of opening in the outlet which will not permit doming; and (2) the other for the width of bin above the hopper which will not allow a permanent funnel to form.

When the hopper gate is first opened, or the feeder started, a dome-shaped mass of material directly above the gate fails and is removed from the bin. If the span of the opening is below a certain maximum, a dome can form

across the opening. If this span is exceeded, the stresses will exceed the strength of the material and the dome will fail, with ensuing discharge of the material. The width of opening which will not allow dome formation is given by:

 $B > b_{\scriptscriptstyle h} \ b_{\scriptscriptstyle v} \ (f_{\scriptscriptstyle e}/w)$

where B is the shorter width of hopper opening (i.e., in the plane of the minor axis), and b, and b, are coefficients depending on the shape of the hopper opening, and the vertical hopper cross section along the minor axis. The first of these coefficients has been computed for elliptical openings and has been found to vary between a value of about 2 where the width L and breadth B of the opening are equal, to slightly over 1 where the ratio of width of opening to breadth is 3. For rectangular hopper openings b, must be found experimentally, but in general is slightly smaller than for elliptical openings of the same L/B ratio. The width of opening that material of a given strength can span is twice as great for a circular opening as for a long elliptic or rectangular opening. However, there is no advantage in extending the opening beyond an L/B ratio of about 3.

Thus a rectangular opening has an advantage but this advantage may be lost in using a feeder to withdraw the material. To retain the effect of a rectangular opening, material must be withdrawn from the entire opening area. But with a feeder as it is usually installed, the material flows to the feeder from the far end only, with material over the rest of the hopper opening supported by material already on the feeder. Thus the effective length of the opening becomes much less than the actual. To assure flow through the whole cross section it is necessary to use a feeder capacity increasing in the direction of flow, for example, a screw with increasing pitch, or a belt or apron feeder with increasing opening from the hopper.

Coefficient b, depends on the vertical cross section of the hopper along the minor axis, that is, on the hopper slope angle α_1 and its height. The unit strength term fe/w in the expression is taken from the flow-factor function for the largest compacting pressure in the bin.

Although dimension B may be chosen to prevent doming, it is still possible for the material to funnel and it is desirable for the design to prevent this possibility also. The bin width which will not permit the formation of stable funnels is given by:

 $D > B + d(f_c/w)$

where D is the bin width in the plane of the minor axis and d is a coefficient dependent on L/B and D/B. Values of the coefficient have been computed 1 and are found to lie between 2 and 5.5.

Sincere thanks are due to Dr. J. Hugh Hamilton, Director of the Engineering Experiment Station of the University of Utah, for allowing the writer the use of facilities of the Station in the execution of this work.

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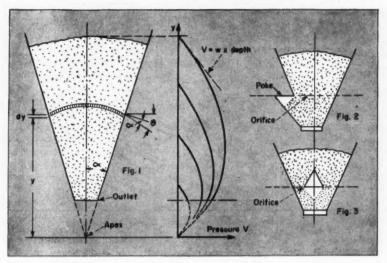
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Hoppers by Calculation?

CHESMAN A. LEE

Recent developments in solids flow theory have brought rational design of hoppers appreciably closer. Janssen's work has long been used in deep bin design, but it previously seemed pointless to apply it to hoppers. However, if his pressure formula has basis, it should also apply to hoppers. Hence his approach has been adapted to hoppers by using, instead of a constant diameter, a variable diameter which is a function of the height above the apex of the hopper, yielding an equation in differential form which is:

 $dV/dy = (w - tan \ 6 \ k \ V/Ry)$ Here V is vertical pressure and kV is lateral pressure; y is height; w is unit weight of the material; R is hydraulic radius (equals area \div perimeter); and tan 6 is the slope of the pressure resultant of material against the wall. Integrating graphically by the method of isoclinals, we can develop a series of curves to show the pressure distribution for various depths of material, obtaining a different curve for each

CHESMAN A. LEE, engineer with Darling & Co., Chicago, has had a long-time interest in what makes a hopper work properly on difficult materials. Hence, he has followed the work of Jenike and others, and has evolved some conclusions of his own.

depth, as in Fig. 1. Each curve starts tangent to the hydrostatic line but no matter where it starts it comes back to zero pressure at a point which would be the apex of the hopper cone if the sides were continued to a point. The maximum value of pressure V comes at a point not quite half way up, and well above the outlet of a conventional hopper.

At first thought the discovery that V = 0 at y = 0 is disconcerting. However, previous experiment has shown that V_{max}. does come well above the outlet, while the work of Jenike (p. 175, this issue) gives experimental proof that all the curves do pass through the point V = 0 at y = 0, the apex. It is important to note the shape of the curves. Ordinarily a hopper is cut off at a point to give the desired outlet size. Thus, the smaller the outlet, the less the discharge pressure, and the less the pressure difference between the various curves, i.e., the less for varied material depth.

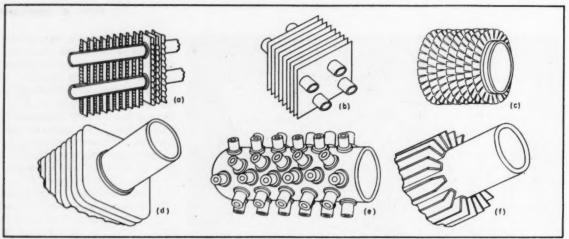
Lacking an exact knowledge of some of the terms of the equation is not too important, since the shape of the curve is the main consideration. For example, we may not know k exactly. Tan θ can't be more than the coefficient of sliding friction at a vertical side and is assumed to be

appreciably less at an inclined wall. If we are consistent the exact values are not too pertinent. Combining some of the terms for simplicity, let $c = R/\tan \theta$ k. Then the equation becomes dV/dy = (w - V/cy), where c is a constant depending on hopper shape. The maximum pressures and outlet pressures vary with c.

Comparing c values for several hoppers (in an actual case where w = 39 lb./cu. ft., and k = 0.521), we find that with conical hoppers with sides sloping at $\alpha = 5$ to 30° from the vertical, c ranges from 0.313 for the 5° hopper, to 0.661 for the 30° hopper. For square cross-section hoppers with the sloping sides at a = 30° from the vertical, the c values depend on the number of sloping sides. With four sloping sides c is the same as for a 30° conical hopper, but drops to 0.504 with one vertical side, and to 0.403 for two vertical sides. So pressures are less with small angles, or one or more vertical sides.

These facts explain some of the methods that have been used to make hoppers free-flowing. The author's last article (May 1953, p. 194) mentioned an expansion hopper with a poke hole (Fig. 2). Like the shelf or cone "pressure breaker" (Fig. 3) referred to by various writers (Jenike, this issue, Nissley, Plant Engineering, June 1953) this produces an orifice at a point where pressure is substantially higher than at the outlet, and usually enough to maintain flow. Below the constriction is a free surface where material will not re-compact.

After much correspondence with those working in the field (e.g., A. W. Jenike, and J. K. Rudd, of Richardson Scale) I conclude that they too feel that their results so far are still somewhat tentative. Our opinions seem to differ only in degree and to be moving toward a common point. In any event, the problem seems to be one of emptying out the lower parts of the hopper up to a point where the internal pressure is more than enough to overcome the cohesion which causes arching. Anything that lowers the discharge pressure (not Jenike's compacting pressure v, but his working pressure p-Ed.) works against us. Anything that raises it helms discharge, and aids us in better design.



EXTENDED SURFACE heat exchangers take varied forms, including cross-fin, pin fin and longitudinal designs.

Practical Finned Tube Design

There are many shapes and sizes of finned tube heat exchangers, but only one practical way of getting heat transfer coefficients for such exchangers. Here is how to do it.

E. J. SKIBA

It is a well known fact that extended heat transfer surface increases the total transmission of heat in exchangers. Many kinds of extended surface forms are available for heat transfer work. The various types can be divided into three basic groups.

First is the group consisting of tubes with cross-fins attached. These cross-fins can be either one fin over one tube, (d) or a series of tubes running through the fins, (a), (b). Included in this group is the helical finned tube, (c), in which the cross fin is spirally wound on a tube.

A second group of extended surface tubes consists of pin fins, (e). These pins extend the surface of the tube considerably. This type of tube has been used to a great extent in economizer sections of boilers. Pins soldered between plates is still another type of extended surface in this second

group. An exchanger with this type of surface allows the hot and cold medium to flow at 90° to each other, or in strict countercurrent flow as well.

The third group of extended surface exchangers are of the type having fins running longitudinally or parallel to the axis of the tube. The bare tube surface can be extended, as in the others, by varying the number and height of the fins. This is shown in (f).

The form which the extended surface takes, and its method of manufacture will limit its application in heat transfer—not only mechanically, but thermally as well.

For example, it would be a little difficult to take a cross-fin type of tube and put it into a reactor effluent-to-feed exchanger for a platforming unit, in which the pressures are very high; where there are temperature crosses between the fluids; and where good alloys are needed to withstand the high temperatures involved in the reactor.

The cross-fin lends itself readily to a box type of exchanger in which there are large flows and relatively small pressure drops allowed through the exchanger; and where operating pressures are relatively low on one stream.

Over-all Transfer Coefficient

Back in the early days of heat transfer design, engineers believed that if a lot of extended surface was put on prime surface, the surface per foot of length would be increased—and the amount of heat that could be transferred to a fluid would be increased appreciably per unit of surface. By using extended surface, it would be possible to offer a more compact exchanger, and therefore less capital cost for the exchanger, resulting in a less expensive unit.

Actually, it is possible to put 6, 8 and 10 times the amount of surface per unit of length, as compared to a bare tube.

One thing has to be realized, however. Bare tube and finned tube sur-

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faces, or over-all heat transfer coefficients, cannot be pro-rated equally.

Fin Efficiency

The reason behind this is fin efficiency. One of the most important concepts in finned tube design, it determines the effectiveness of the surface added to the bare tube.

Fin efficiency is defined as the heat transfer coefficient at the base of the fin, divided by the heat transfer coefficient over the fin. In other words, when there is a fluid going past the fin, a certain film coefficient is expected—but this coefficient must be corrected before an over-all transfer coefficient can be calculated.

Why? Because the skin temperature along the height of the fin varies. The amount of heat transferred in an exchanger (Q) is equal to an over-all transfer coefficient (U), times an area (A), times a Log Mean Temperature Difference:

$$Q = (U)(A)(LMTD)$$

The LMTD is the driving force in heat transfer.

Altering the skin temperatures changes the LMTD, and altering the amount of heat which can be transferred.

What Controls Fin Efficiency?

There are four factors which control or which affect fin efficiency:

1. The first factor is the conductivity of the fin material itself. A copper fin is capable of transferring more heat than a stainless steel fin because its conductivity is so much greater. In other words its resistance to heat flow is less.

2. The second factor is the thickness of the fin. As the fin thickness is increased, the cross sectional area is increased for heat flow. The fin attempts to approach the tube wall temperature rather than the fluid passing over the fin. The LMTD is greater than it would be when compared with a thin fin; hence the efficiency is high, because a thick fin offers less resistance to heat flow.

3. Fin height is a third factor affecting fin efficiency. The longer the path for heat flow the more resistance there is thrown into the system. This is analogous to an electrical conductor or a wire carrying current. The longer

the wire the greater is the voltage drop across it. The fin temperature is lowered with a resulting loss in LMTD, hence the efficiency is lowered.

4. A fourth factor is the film coefficient itself. As the finside film coefficient is increased appreciably—up into the higher regions of 1,000 Btu. per hr. per sq. ft. per °F.—the fin temperature just naturally tends to go to the temperature of the fluid outside.

This is so, because the resistance of the fin itself to heat flow is the controlling factor or bottleneck. Heat flow through the fin metal is not rapid enough to take care of all the heat and transfer it to the base of the fin. Therefore, the temperature of the fin naturally tends to go to the temperature of the fluid outside. When this happens there is a loss in LMTD, and the efficiency is very low.

Referring to the plot of efficiencies for longitudinal fins, compare two ½-in. high steel fins; one is 0.035-in. thick and the other is 0.050-in. thick; at a constant film coefficient of 40 Btu. per hr. per sq. ft. per °F. The fin efficiency for the ½-in. high, 0.035-in. thick fin, is roughly 64%. By increasing the thickness to 0.050 in. this efficiency is increased to 69%.

The same 1-in. high fin in admiralty

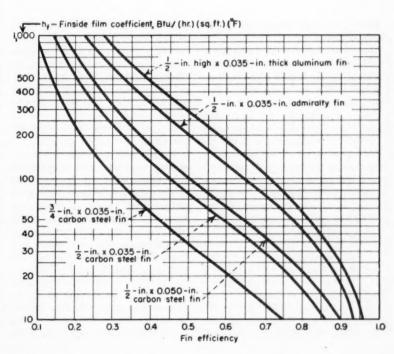
metal has a fin efficiency of 82%. The aluminum fin has better conductivity than either steel or admiralty and its efficiency for this film coefficient is 85%. This shows how the conductivity of the metal as well as the thickness affects the fin efficiency.

Now compare the ½-in. x 0.035-in. thick with the ½-in. x 0.035-in. thick fin. For a rate of 40 Btu. per hr. per sq. ft. per °F., the efficiency on the ½-in. fin is down to about 47%, compared with 64% for the ½-in. fin. But there is one thing that must be considered; by increasing the fin height the surface is also increased. Normally the gain in surface is more than the decrease in fin efficiency. This point must be considered to find out which is the most applicable fin to use in a particular service.

How to Use Fin Efficiency

The fin efficiency becomes important in computing the over-all heat transfer coefficient (U). In practice, the finside film coefficient is multiplied by a fin efficiency factor. How this is done is shown in Table I.

Remember that the total surface offered on the outside of the tube is broken down into prime surface (bare tube) plus extended surface



Calculation of Coefficient Using Fin Efficiency—Table I

Finned Tube Data

Tubeside film coefficient

Material	Carbon steel
Number of fins	24
Fin height	1/2 in.
Fin thickness	0.035 in.
Tube size	11/2-in. IPS (1.9-in. O.D. x 1.61-in. I.D.)
Total external surface	21/2 sq. ft./ft.
Fin surface/total surface	0.80
Tube surface/total surface	0.20
Total external/total internal surface	5.93
Finside film coefficient	40 Btu./hr./sq. ft./F.

40 Btu./hr./sq. ft./F.

2,500 Btu./hr./sq. ft./F.

Over-All Heat Transfer Coefficient Calculation

Fin efficiency = 0.64 (chart) Weight fin efficiency = $0.64 \times 0.80 + 1.0 \times 0.20 = 0.712$ Corrected finside film coefficient = 40 × 0.712 = 28.48 Btu./hr./sq. ft./F. Equivalent tubeside film coefficient = 28.48 × 5.93 = 168 Btu./hr./sq. ft./F., inside tube area.

U. Calculation

1/168	= 0.00595
1/2,500	= 0.00040
1/tube wall coefficient	- 0.00048
4/11.	- 0.00493

Based on inside tube surface, Ui = 146 Btu./hr./sq. ft./F. Based on outside surface (total), Uo = 146/5.93 = 24.6 Btu./hr./sq. ft./F.

(fin). The total surface on this particular finned tube is 21 sq. ft. per linear foot of pipe. The fin surface is 80% of the total surface; the prime surface (tube) is 20%. The total external surface to total inside surface is 5.93:1.

In calculating the over-all transfer coefficient, the finside film coefficient of 40 Btu. per hr. per sq. ft. per °F. is used for the oil. With steam in the tubes use a condensing film coefficient of 2,500.

From the graph, this fin has an efficiency of 64% for the finside film rate of 40 Btu. per hr per sq. ft. per °F.

Weighted Efficiency

This efficiency is applied to that portion of the total surface which is fin surface—the bare tube surface has an efficiency of 100%. The efficiency is applied to the fin surface only, which is 80% of the total surface. The total efficiency or weighted

efficiency is 64% of 80%, plus 100% of 20% (tube prime surface). In this case it is 71.2%. After that is determined, the corrected finside film coefficient is 71.2% of 40 or 281 Btu. per hr. per sq. ft. per °F. (of total external surface). This is the amount of heat that is being delivered to the tube wall or to the medium inside the tube.

Normally the corrected finside rate is then converted to an equivalent tube side rate. Then the resistance, or the reciprocals of these coefficients, can be added to give an overall rate based on the inside surface of the tube.

In this particular case there is 5.93 times as much surface outside the fintube as there is inside. Therefore, an equivalent tubeside rate would be 5.93 times the corrected finside film coefficient or 168 Btu. per hr. per sq. ft. per °F. From here on the calculation of the over-all heat transfer

coefficient is identical to any bare tube.

The reciprocals of the coefficients, or the resistances, are added to give a total resistance. The reciprocal of this resistance gives the over-all transfer coefficient based on the inside tube surface. In this case it is 146 Btu. per hr. per sq. ft. per °F. The over-all rate then-based on the outside surface-is 146 divided by the ratio of outside to inside surface (5.93). This gives a transfer coefficient of 241 Btu. per hr. per sq. ft. per °F. based on the external surface.

Increase Number of Fins

On the same tube, 11 in. IPS used in Table I, there is also a possibility of putting on 36 fins 1-in. high, thereby increasing the surface to 3½ sq. ft. per linear foot of pipe. The calculation of the coefficient for this condition is shown in Table II.

The same finside film coefficient is used as in Table I. Actually there would not be too much of a difference in film rates, because the net free area has not changed appreciably. The number of fins, however, has been increased to 36.

In this case the total external surface per linear foot of pipe is 3½ sq. ft. per foot. The fin surface comprises 86% of the total surface. The bare tube surface, which is 100% efficient, is 14% of the total area. By increasing the number of fins, the ratio of outside surface to inside surface has been increased from 5.93 to 8.3.

The fin efficiency itself is not affected by changing the number of fins. Fin efficiency for this height fin and this thickness, with a film coefficient of 40 Btu. per hr. per sq. ft. per °F., is still 64%.

However, the weighted fin efficiency-because of the change in ratios of fin surface and prime surface-has been changed. It is now 64% of 86% (which is the fin surface to total surface ratio) plus 100% of 14% which is the tube surface to total surface ratio. The weighted fin efficiency is-

The corrected finside film coefficient is 27.6 Btu. per hr. per sq. ft. per °F. (40 x .69)—slightly lower than in

However, the equivalent tube side

coefficient has been increased appreciably because of the greater ratio between the outside and inside surface. The equivalent tubeside film coefficient now is 229 Btu. per hr. per sq. ft. per °F. of inside surface (8.3 x 27.6). Again by adding up the reciprocals of the film coefficients the inside equivalent rate is 191 Btu. per hr. per sq. ft. per °F.

The Effect of Increasing Fins

Over-all heat transfer rate, based on the fin surface, is arrived at by dividing the rate based on the inside tube surface by the ratio of external to internal surface. In this case the rate is 23 Btu. per hr. per sq. ft. per °F. (191/8.3). This is slightly lower than the rate in Table I. However, in analyzing the amount of heat given off by the finned tube in Table II as compared to Table I, you will find that the finned tube in Table II gives off 80.5 Btu. per hr. per °F. based on one linear foot of tube (23 x 3.5). In Table I the value is only 61 Btu. per br. per °F. (24.5 x 2.5).

In other words, by adding on another sq. ft. of fin surface per linear foot, the heat pick-up has been increased by approximately 30%. This, of course, would make the heater more compact.

The comparison of these first two cases shows how varying the number of fins on a tube not only varies the over-all heat transfer coefficient, but also varies the amount of heat exchanged per linear foot of finned pipe.

In carrying this study of finned tubes a little further, there is one other large factor which should be considered; the effect of fouling on the fin surface.

Fouling Resistance

In Table III there is an analysis of a finned tube vs. baretube with the same fouling resistance taken into consideration. To put the baretube unit equal to the finned tube unit, it's necessary to make the bare tube tubeside coefficient equal to the finned tube equivalent tubeside coefficient. Referring to Table I, the equivalent tubeside coefficient for the finned tube is 168 Btu. per hr. per sq. ft. per °F.

Using this rate as the film coefficient of oil in the bare tube section, and also assuming that the bare tube

Coefficient Calculation. The Effect of More Fins-Table II

Finned Tube Data

Tubeside film coefficient

Material Number of fins Fin height Fin thickness Tube size Total external surface	Carbon steel 36 1/2 in. 0.035 in. 11/2 in. IPS (1.9 in. O.D. x 1.61 = in. I.D.) 31/2 sq. ft./ft.
Fin surface/total surface Tube surface/total surface Total external/total internal surface	0.85B 0.142 8.3
Finned tube coefficient	40 Rtu /hr. /sra. ft. /F.

Over-All Heat Transfer Coefficient Calculation

Fin efficiency = 0.64 (chart) Weighted fin efficiency = 0.64 \times 0.858 + 1.0 \times 0.142 = 0.69 Corrected finside film coefficient = 40 \times 0.69 = 27.6 Btu./hr./sq. ft./F. Equivalent tubeside film coefficient = 27.6 \times 8.3 = 229 Btu./hr./sq. ft. /F inside tube area

2,500 Btu./hr./sq. ft./F.

U. Calculation

1/999	= 0.00436
1/9,500	= 0.00040
1/tube wall coefficient	= 0.00048
1/U ₁	= 0.00524
Based on inside tube surface, U ₁	= 191 Btu./hr./sq. ft./F.
Based on outside surface (total), U ₀	= 191/8.3 = 23 Btu./hr./sq. ft./F.

Heat Pickup/F./Linear Ft.

Table I
$$-2.5 \times 24.6 = 61.5$$
 Btu./hr
Table II $-3.5 \times 23.0 = 80.5$ Btu./hr.

is rather thin-walled, the clean overall transfer coefficient for the bare tube is 153 Btu. per hr. per sq. ft. per °F. The calculated clean rates for the finned tube and bare tube are 24.6 and 153 Btu. per hr. per sq. ft. per °F. respectively.

Calculate Fouled Coefficient

Calculating the fouled over-all heat transfer coefficient is the next step. Using 0.002 as the oil fouling resistance changes the finside film coefficient from 40 to 37 Btu. per hr. per sq. ft. per °F. The fin efficiency for this coefficient is now 66%, or 2% higher than it was for the clean fin film coefficient. This brings out the fact that as the fin film coefficient is decreased efficiency is increased. The weighted fin efficiency is approximately 73%. And the corrected finside fouled film coefficient is 26.9 (.73 x 37) Btu. per hr. per sq. ft. per °F.

The equivalent tubeside coefficient is 159 (5.93 x 26.9) Btu. per hr. per sq. ft. per °F. The over-all transfer coefficient based on the inside tube surface for the finned tube is 135 Btu. per hr. per sq. ft. per °F. Dividing by the ratio of outside to inside surface (5.93) the fouled over-all heat transfer coefficient based on the finned surface is 23.4 Btu. per hr. per sq. ft. per °F.

For the bare tube heat transfer coefficient, using 0.002 as the added resistance due to fouling, the design rate based on the outside tube surface is 117 Btu. per hr. per sq. ft. per °F.

Therefore the surface added to the finned tube unit to take care of fouling is 5%. The surface added to the bare tube unit to take care of the fouling is 30%.

Tubeside Fouling

The last part of the calculation in Table III also considers the effect of

FIN TUBES . . .

Calculation of Coefficient Taking Fouling Into Account—Table III

Service: condensing steam in an oil heater, with fouling.

Material: carbon steel

Finned tube: 24, 1/2-in. by 0.035-in. fins on 1 1/2-in. IPS Sch. 40 pipe.

Baretube: thin walled tube.

Known Coefficients	Finned Tube	Baretube (Based on external surface)
Oil film coefficient	40	***
Equivalent tubeside film coe	ff. 168	168
Clean over-all transfer coeff.	24.6	153

Fouling-Oil Side Only

Oil fouling	0.002	0.002
Fouled film coeff.	500×40/500+40=37	500×168/500+168=196
Fin efficiency (chart)	= 0.66	• • •
Weighted fin efficiency	= 0.66×0.8+1.0 ×0.2=0.728	1.0
Corrected fouled film coeff.	= 0.728×37=26.9	1×126=126
Equivalent tubeside film coeff	- 96 0 × 5 03 - 150	

Over-All Heat Transfer Coefficient Calculation

1/159	- 0.00630	1/126 = 0.00794
1/2,500	= 0.00040	1/2,500 = 0.00040
1/tube wall coeff.	- 0.00048	1/tube wall = 0.00020
1/U _i	- 0.00718	1/U _o = 0.00854
$U_i = 139$, $U_o = 139/5.93$	= 23.4	U ₀ = 117
Added surface for fouling (oil)	= 5%	30%
The tube fouling factor is 0.00	1	
$1/U_i = 0.00718 + 0.001$	- 0.00818	$1/U_o = 0.00854 + 0.001 = 0.00954$
$U_i = 122 U_o = 122/5.93$	= 20.7	U _o = 105
Total added surface for to	tel fouling 19%	46%

fouling on the tubeside. By assuming that the heating medium is an exhaust steam, the fouling factor or resistance to be used on the tubeside is 0.001. The fouled over-all transfer coefficient, considering the fouling on the oil and the steam, gives a value of 20.7 and 105 Btu. per hr. per sq. ft. per °F. for the finned tube and bare tube design respectively. Therefore, the additional surface required to take care of fouling on both mediums is 19% for the finned tube and 46% for the bare tube.

In summary these three cases give an insight to the manner in which the over-all heat transfer coefficient for finned tube is calculated, taking into consideration the fin efficiency and fouling factors. Actually, fouling on the fin side does not affect the overall design too greatly because the increase in fin efficiency tends to offset the effect of fouling.

The calculations also point out that when the heat transfer film coefficients in any application diverge either because of better thermal properties on one stream or greater flows, a finned tube design should be tried.

General Applications

There are quite a few applications for extended surface heat exchangers. Here are some of them:

1. An air heater or cooler is one application most likely to be an extended surface application. Air has

very poor heat transfer characteristics so that regardless of what other fluid is being used to heat or cool it the air will probably have the lower heat transfer film coefficient. The air then would be on the finside of the tube with the other medium flowing in the tubes.

2. Exchanging heat between a viscous fluid and a light fluid has great possibilities for an extended surface design again because viscous fluids do not usually have very good heat transfer characteristics as compared with fluids of much less viscosity. A typical example is a 15° API crude being heated by gasoline.

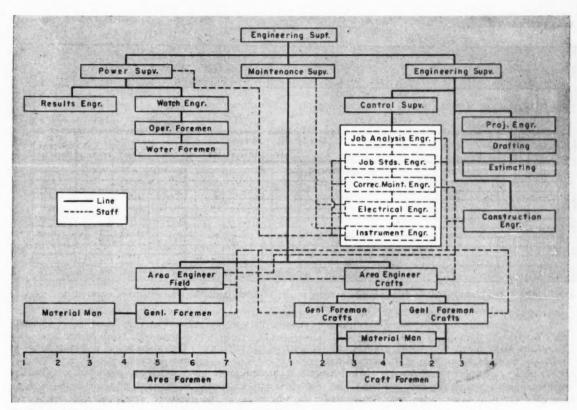
In these examples extended surface may prove successful because one fluid has better heat transfer characteristics than the other. When such conditions exist the fin surface is put in contact with the fluid having the lower film coefficient.

3. The fluids do not necessarily have to be different before a finned tube application is to be considered. Fluids may be identical in all their heat transfer characteristics and still be used in finned tube exchangers. A typical example is a high pressure gas to a low pressure gas. Usually in cases of this type the pressure drop restriction on the low pressure gas is more severe than the pressure drop for the high pressure gas. The density of the high pressure gas is greater and as a result better velocities and a better film coefficient for the high pressure gas can be attained as compared with the low pressure gas. The low pressure gas would be passed over the fins.

4. In cooling wax-oils there is always the problem of having cold surfaces on which the wax will solidify. By using finned tubes, the seriousness of the problem is lessened. The fin surface is at a higher temperature than a bare tube surface because the fin efficiency is hardly ever 100%. As shown before the fin efficiency is a correction on the MTD.

For the same reason, fluids which are heat sensitive will be exposed to lower skin temperatures in an extended surface heater than in a baretube heater.

These are just generalities which point out those applications where extended surface heat exchangers should be considered.



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IT DEMANDS: Best available talent in: (1) engineering, and (2) management.

HENRY SHOCKLEY

High maintenance costs and keen competition are forcing a change in the whole philosophy of chemical plant maintenance. This change is in the direction of eliminating repairs through a basic understanding of the conditions causing these repairs.

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Necessary to this basic understanding are considerations of (1) organization, (2) principals, (3) shops and

tools, (4) prevention and correction, and (5) cost charts and statistics. These will be taken up in order.

ORGANIZATION: More Engineers in Maintenance Work

The new look in maintenance entails among other things greater use of engineering personnel in various functions as indicated on the above organization chart. Formerly, the lone engineering representative was the in-

dividual at the head of the maintenance department. Today, even the maintenance foreman may be a graduate engineer.

Note on the above chart the technical assistance (shaded area) now avail-

	Equipment: Specification					Code No Bldg. No			
Date	Date Shop Order No. Description of Work	Labor			Material			Total Labor and	
		Const.	Direct	Indirect	Const.	Direct	Indirect	Material	
		Brought Forward							
_									
_				+-+					

EQUIPMENT HISTORY CARDS show whether problem is one of labor, methods, or materials of construction.

able to the maintenance department. Technical assistance is provided as a staff or service function by the various engineers reporting to the engineering supervisor. It has come into being because experience over the years indicates that supervision of maintenance work and carrying out of improvement programs cannot be done by the same people. This experience shows also that unless improvement is associated with a definite program under personnel who are wholly responsible for it being done, little in the way of real results can be expected.

Other differences between a maintenance organization created for repair purposes and one developed for prevention and correction are (1) reduction in the foreman-mechanic ratio (from 1 to 20 or 30 down to 1 to 8 or 15) for the purpose of giving the foreman time to properly carry out his duties, (2) careful selection and specialized training of mechanics in the various techniques for properly maintaining process equipment, and (3) increased understanding of human re-

lations on the part of maintenance supervision.

Maintenance in a chemical plant is today just one of several functions coming under the supervision of the works engineer, plant engineer, or engineering superintendent. He may have three other major responsibilities: (1) utilities, (2) project preparation, design, and minor construction, and (3) technical assistance. Each of these groups is headed by a competent engineer who is capable of supervising that particular phase of the work.

In the functioning of the utilities section, maintenance work may be the direct responsibility of either the power engineer or the maintenance department. In either case, that part of the work load involving the use of major tools and equipment will be a function of central shops.

In the project section or in the technical assistance section, there may be other engineering services such as electrical, instrumentation and lubrication.

Technical assistance to the mainte-

nance department is gaining momentum. Operating departments have had technical groups and other staff assistance investigating and improving their procedures for a long time. It's becoming just as important, due to today's high cost and the greater complexity of maintenance work, for technical groups to devote full time to the maintenance department. Here they help in the prevention of mechanical breakdowns and investigate abnormal repair conditions.

At a recent annual Plant Engineering and Maintenance Conference, I stated that the ratio of maintenance personnel to operating personnel in some du Pont chemical plants was as low as 1 to 1, and in others, 1 to 3. In a local paper, they quoted me as saying 1 to 1 and 3 to 1. Quite frankly, such may not be a false prophecy for the future, after all. As we continue to improve the technology of our plant operation, which we must do to maintain high productivity and low unit costs, the ratio of maintenance personnel to operating personnel will rise.

PRINCIPAL CONTROLS: Effective Devices, Not Just Paperwork

Maintaining a plant today is a real business proposition. From the inception of a repair or minor construction job to its completion, everything must be done to be sure that the work is (1) necessary, (2) properly approved,

(3) effectively executed, (4) correctly costed and (5) recorded for preventive and corrective purposes. To accomplish this, certain principals are being followed to an increasing degree.

REPAIR ORDER SYSTEM

First of these principals is the repair order system. This system provides a written contract to spend money or do work, establishes a procedure where definite approvals are necessary, offers a follow up for progress and completion of the work, utilizes records available as to labor and material cost, and serves as a basis for preplanning and measurement of maintenance work. Repair orders should call for only the essential information so that supervision will have the time to properly supervise their work and so that they will not be tied up with excessive clerical duties.

Processing of the repair order, which is a foreman's function, consists of (1) review of the job location, (2) planning the job, (3) scheduling the job and (4) inspecting the job upon completion.

While assistance may be given the foreman by a member of the technical assistance group, there are things which the originators of work orders (operating men, area engineers, research and development engineers) can do in getting a better job done. These include such things as putting dimensions on sketches, amplifying requests with pertinent information and giving consideration to time required by maintenance engineers in developing job requirements.

Initially, we indicated how the foreman-mechanic ratio had been reduced from 1 to 20 or 30 men down to 1 to 8 or 15. It is obvious from this that recognition is given to allowing the foreman time to properly carry out his duties and responsibilities as those responsibilities are still essential to successfully securing good work performance. However, a little planning on the part of the persons wanting the job done can mostly help the foreman do a better job.

EQUIPMENT HISTORY CARDS

Another very important principal for maintenance work control is the equipment history card. Too often, its application has been so misrepresented or misunderstood that its real value has not been realized.

Before indicating how it should be installed and maintained, let's look at its value.

Equipment in operation is adversely affected by such factors as abrasion, corrosion, lack of lubrication, faulty operating techniques, poor design and continuous or intermittent operation.

A repair job indicates that certain parts of the equipment involved have been adversely affected due to some inherent weakness or unfavorable operating condition.

Experience has indicated that these conditions cannot be retained by memory. Nor can records of these conditions be kept in a slip-shod manner if they are to be used for prevention or correction. At the same time, explanation of the repairs must be kept to a minimum of words covering only practical information.

For instance, if a pump is repacked, a statement to that fact (such as pack mechanical seal or pack with flax packing)—with labor and material costs—is all that is required.

If that pump is overhauled, on the other hand, you might expect a detailed record of what was done. However, experience indicates that space and time do not allow a full description of the work done to be recorded on the history card. The term "overhaul" and money in labor and material is about the maximum that can be recorded

This difficulty can often be overcome and a start made toward standardization by establishing a standard practice for overhauling that pump or any piece of equipment. This requires that all operations be recorded in sequence together with materials, spare parts, skills and tolerances.

The economy of this operation is that little further analysis is necessary when the same job is done again, except to check the extent of the work done for work requirements and cost purposes.

Equipment history cards show over a period of time where the maintenance money is spent, points of equipment weaknesses, and whether the maintenance problem is one of labor, methods, or materials of construction. They also promote the use of better maintenance techniques. Replacement

Don't Forget Maintenance in the Proposed Plant!

Much can be done to ease start-up, minimize changes, and keep operating costs low by thinking about maintenance before your new plant gets into operation—while it is in the design stages.

Most important in your analysis will be determination of the maintenance work load. In this connection, every piece of equipment should be reviewed as to kind of maintenance required, ease of dismantling and assembly, type of drive, and operation served. Standard practice for repairs should be established covering (1) sequence of steps, (2) skills involved, (3) normal and special tools required, (4) materials or spare parts that require frequent replacement.

Such a study will reveal the possible extent of repairs and repair costs as well as weaknesses of each piece of equipment in the process cycle. It may show that certain pieces of equipment are not fitted for the job, or indicate that further study is necessary.

This study will also show: (1) the various skills necessary to maintain the plant, (2) how many of each skill will be required, (3) whether the work re-

quirements are such that only day maintenance is required or whether shift maintenance is also required, (4) the kind of work that should be done in the areas and that which is adaptable to central shops and tools, and (5) the kind and number of machine tools, cutting tools and hand-powered tools to supply all skills, both in central and area shops.

Experienced engineering personnel are required for such an analysis. This explains the trend toward increased numbers of engineers in the maintenance department of chemical plants.

of equipment in whole or part is often indicated as the most economical solution

History cards show where the frequency of overhaul needs to be changed due to excessive repairs, and

whether the maintenance problem is confined to a certain part of the equipment or is general.

OTHER POINTS OF CONTROL

There are many other important

controls such as scheduling work, establishing optimum backlogs, establishing inspection schedules, determining standard tools and the like. They also play an important part in proper plant maintenance.

SHOPS AND TOOLS: Better Equipment for Lower Cost, Less Downtime

Since the war, great strides have been made in using shops and tools for greater pre-fabrication of work previous to its assembly in the field. Many unique maintenance tools have been placed on the market. There are few maintenance operations that will not be affected by improved hand, handpowered, and machine tools as well as by improved craft equipment and techniques.

Today we are working with higher

feeds and speeds, greater power requirements, better cutting tools and better knowledge of sharpening and cutting methods.

Motivating these developments are high costs and the need for minimizing downtime of operating equipment. Requirements of close tolerances and super finishes have also had their effect

Improvement in shops and tools extends to area shops, where progressive

field techniques are being applied to process equipment that cannot be brought to the central shops.

There is a need for engineers with over-all tooling experience, because ingenuity, good judgment and experience were never of greater value than they are today in designing tools, jigs and fixtures for special jobs. The need for proper mechanical training is apparent for these tools and equipment to be operated to the best advantage.

PREVENTION & CORRECTION: Front and Center for Engineered Maintenance

Today we hear much of preventive maintenance. It consists of planned and coordinated inspections, adjustments, repairs and replacements in maintaining an industrial plant.

Its scope covers four categories: (1) routine maintenance jobs; (2) standard tasks such as lubrication, small and repetitive jobs; (3) inspection and overhaul schedules of major equipment, buildings and facilities; and (4) spare parts and extra machinery.

Fundamentally, the results to be expected from preventive maintenance are: (1) minimum operating downtime, (2) better over-all scheduling and planning, (3) discovery of weaknesses in materials and equipment, and (4) promotion of the use of standard techniques.

Objective of the progressive plant is to pass from the repair stage to that of engineered maintenance. This means that preventive maintenance begins with the new plant and engineered maintenance is performed in the going plant.

Many persons have felt that preventive maintenance and corrective maintenance are closely akin. Rather than attempt to argue the question, we will define corrective maintenance, give its scope and results, and leave it to you as to whether a difference or relationship exists.

Corrective maintenance is defined as the application of re-design, better materials of construction, new methods and engineering techniques for the improvement of operating equipment and facilities for an industrial plant.

The purpose is to improve operating life of equipment, eliminate loss of product, and to reduce corrosion, abrasion, waste.

Its scope covers the use of equipment history cards, records, investment summaries to indicate where conditions for correction occur. Results: (1) minimum operating difficulties,

(2) increased yield and quality of product, (3) increased volume of product, (4) lower operating costs.

It would seem that where preventive maintenance is a tool for reducing maintenance costs of present operating equipment, corrective maintenance attempts to improve the equipment or correct unsatisfactory conditions to further reduce over-all plant costs.

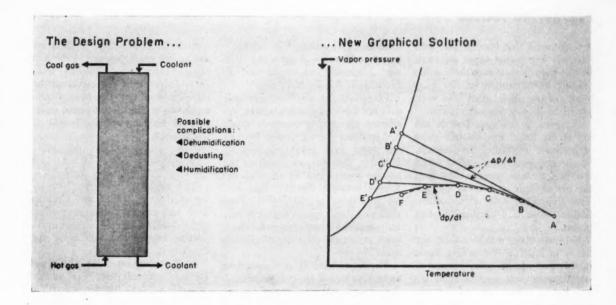
COST CHARTS & STATISTICS: Engineering Techniques Alone not Enough

Our experience has shown that a better understanding of cost and statistical data by engineers is critically

Many persons react to this statement by saying that engineers are more interested in their particular fields of work than in worrying about costs. But all of us know that very few things can be done in industry unless they can be evaluated in terms of money. Conversely, many projects have failed because this evaluation of costs and statistics was not done or was misunderstood.

Every plant has its own method of costing and in most cases more than sufficient information is available. Cost charts showing investment, total maintenance cost, percent of investment, total production, and units of production per maintenance dollar-if charted over the years-can do much to indicate whether a plant is getting its full worth from its capital and maintenance dollar.

It is essential that engineering techniques be used to their fullest extent in maintaining a chemical plant. Unless, however, they are tied in with cost, they will be neither wholly understood nor accepted by plant management.



HOW TO . .

Design Gas-Cooling Towers—I

Here's a reliable design method to help you calculate intermediate temperatures and vapor pressures when simultaneous heat transfer, humidification and dehumidification take place.

G. H. P. BRAS

Gas-cooling towers are used in various industrial plants for the direct cooling of hot gases with water or other liquids. Such towers are frequently used for cooling hot producer gas, blast furnace gas or hot gases from sintering machines. Another application is sometimes found in solvent recovery plants when gassolvent vapor mixtures are treated with cold liquid solvent.

In many cases the cooling towers perform a double duty since they can be used for simultaneous cooling and dedusting of hot gases. The gas-cooling tower is essentially a scrubber in which a flow of hot gases and cold liquid is maintained, often countercurrently. When dusty gases are to be handled, the cooling tower is usually designed as a spray tower to prevent clogging of the packing. In other cases towers filled with woodgrid packing are preferred—for instance for cooling hot producer gas.

The gases are cooled by direct contact with the colder liquid and the rate of cooling is usually governed by the rate of convectional heat transfer, although heat transfer by radiation may be met in some cases.

WHEN THERE'S HUMIDIFICATION

When the partial vapor pressure of the cooling medium is greater than its partial vapor pressure in the gas, the gas will be simultaneously cooled and humidified. In this case the rate of heating up of the cooling medium by the heat transferred from the gas is decreased by the heat consumed in evaporation.

At the wet-bulb temperature of the gas, the heat transferred from the gas equals that consumed by evaporation. Thus, the temperature of the cooling medium can not be raised above the wet-bulb temperature of the entering gases (assuming that the temperature of cooling medium entering the tower is less than the wet-bulb).

But if the temperature of the entering liquid is higher than the wetbulb temperature of the entering gases, the liquid temperature could not fall below the wet-bulb temperature. Exceptions might be caused by radiation heat transfer and the effect of incompletely wetted packing.

We usually find simultaneous cooling and humidification of hot gases in the lower part of industrial gas-

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cooling-towers that handle gases with relatively low partial vapor pressures. In this part of the tower there is significant humidification as the gases meet warmer liquid that has been heated on its way down the tower.

However, as the gases flow to the top of the tower they contact water of gradually decreasing temperatures. So the gases may meet cooling liquid that has a vapor pressure less than the partial vapor pressure in the gas. That will be the point where humidification stops and dehumidification begins.

Evidently there will be a great tendency to heat up the cooling liquid in this part of the tower because of simultaneous heat transfer from the hot gas by convection and by condensation of the diffusing vapors. Of course, it is possible to choose the conditions in the tower in such a way that only humidification or dehumidification occurs.

SCRUBBER-COOLER DESIGN

Since the cooling of hot gases in scrubbers depends on both heat and mass transfer processes, we must know both heat and mass transfer coefficients for calculating the required tower and packing volume. We should also know the average temperature or partial pressure difference in the tower.

Heat and mass transfer coefficients for various tower packings and for spray towers as reported in the literature are reviewed by Perry' and Sherwood and Pigford'. Data for woodor ceramic-grid packing have been presented by Kowalke, Hougen and Watson⁴, Johnstone and Singh⁸, and by Molsted, McKinney and Abbey⁸.

Furnas and Newton' have presented data for the over-all heat transfer coefficient for cooling towers in which hot producer gas was cooled by cold sea water over wood-grid packing. However, their data are based on the average logarithmic temperature difference between the inlet and outlet conditions of the tower. They state that their method is correct only for calculating cooling towers in which gases are cooled by a nonvolatile solvent.

The logarithmic mean temperature cannot be used if appreciable humidification and dehumidification are involved. As Furnas and Newton have pointed out, knowledge of the temperature and partial vapor pressures at intermediate points in the tower is required for the exact solution of the design problem.

As far as we are aware, no method has been proposed thus far by which temperatures and partial vapor pressures at intermediate points in the tower can be calculated. It is the purpose of this article to present such a method, which may be useful as a more reliable and general procedure for hot gas scrubber-coolers and similar equipment.

DESIGN EQUATIONS

Recently the author presented a general method for the design of coolercondensers for mixed vapors and noncondensing gases.* The temperature and partial vapor pressure of the gas-vapor mixture was followed from point to point in the condenser by using a graphical step-by-step procedure on a temperature-partial vapor pressure diagram and application of the equation

$$\frac{dp}{dt} = \frac{\Delta p}{\Delta t} \left(\frac{P - p_v}{p_{gJ}} \right) \left(\frac{c \rho D_v}{k} \right)^{2/\delta} \quad (1)$$

This equation was derived by making use of the Chilton and Colburn heat and mass transfer correlation and should not be used without modification beyond the validity of the correlation.

In the derivation of Eq. (1) it was further assumed that the surface available for heat transfer is equal to that for mass transfer. This assumption is valid in spray towers and for packed towers with completely wetted packing in the absence of heat transfer by radiation.

Eq. (1) contains no correction factor for the sensible heat transferred by the diffusing vapors. If a correction factor of this kind is wanted, we can use the theory originally developed by Ackermann. He has pointed out that the differential equation for this case is

$$\frac{d^3t}{dy^3} - \frac{w_r}{k} \cdot \frac{dt}{dy} = 0$$
(2)

Ackermann integrated this equation and obtained an expression for the temperature in the film:

$$t = (c_1/b)e^{by} + c_2$$
(3)

in which $b = w_r/k$; and c_1 and c_2

What About Dedusting in Scrubber-Coolers?

A full discussion of the mechanism of dedusting is out of the scope of this article. It is well known that the rate of gas dedusting depends on a great many factors such as particle size, age of the aerosol and its electrostatic charge. In the case of fogs containing very small droplets, such properties as vapor pressure, surface tension and wettability are important factors. Because of the many factors involved, industrial dedusting and defogging processes used varied equipment (see "Entrainment Separation," Chem. Eng., Oct. 1953, p. 213).

p. 213).

The dedusting problem in a scrubber is a many-sided problem. The coarser dust particles may be separated by impingement with the packing or with the scrubber

liquid. When dust particles can be wet by the scrubber liquid they may take up moisture, become heavier and easier to separate in the scrubber or in subsequent equipment.

In a gas-cooling tower the conditions can be chosen in such a way that the gas becomes saturated in the tower. Further cooling may cause supersaturation and subsequent condensation in the gas phase or in the gas film. This process is often accelerated in industrial gas-cooling towers by the introduction of hot water or steam somewhere between the top and bottom of the tower. Condensation in the gas phase or gas film will occur preferentially around gas ions or wettable dust particles.

It is evident that if condensation occurs

on small dust particles acting as nuclei, these particles will increase their size and become heavier. This will speed their segregation. However, condensation in the gas phase or gas film requires a certain amount of supersaturation. This is likely to be established in the gas film between the saturated gas and the cold liquid.

The critical degree of saturation at which formation of water droplets becomes suddenly noticeable is different for various saturated vapors. It also depends on the temperature of the gas, its content, content of ions and dust nuclei and on the nature of the scrubbing liquid. The reader who is interested in the kinetics of fog formation is referred to Volmer's theory on the subject (see Ref. 11).

are integration constants which can be evaluated by substitution: $t = t_0$ at $y = y_i$ and $t = t_i$ at y = 0.

Equations are then developed for the total heat transferred through the gas film in the direction of gas flow, for two cases. In one case $w_r > 0$ and in other $w_r < 0$.

However, the double set of equations can be avoided if we approach the problem a bit differently and develop equations for the apparent heat transfer coefficient. This can be done by differentiating Eq. (3):

$$\begin{array}{ll} dt/dy \, = \, c_1 e^{by} \\ & = - \, b(t_i \, - \, t_g) e^{by}/(e^{by} \, - \, 1) \end{array} \eqno(4)$$

Now we can substitute values for dt/dy at the gas side of the film, where $y = y_1$, and at the interface where y = 0.

$$\left(\frac{dt}{dy}\right)_g = \frac{-b(t_i - t_g)e^{by1}}{e^{by1} - 1} \tag{5}$$

$$\left(\frac{dt}{dy}\right)_i = \frac{-b(t_i - t_g)}{e^{by!} - 1} \tag{6}$$

Further, these equations can be combined with the general equation for heat transfer from the wall (interface) to the gas

$$Q = -k(dt/dy)$$

Now if Eq. (5) and Eq. (6) are substituted into Eq. (7), we obtain the actual heat transferred at the gas side of the film and the interface.

$$Q_g = kb \ \Delta t e^{by1} / (e^{by1} - 1)$$
 (8)
 $Q_c = kb \ \Delta t / (e^{by1} - 1)$ (9)

$$Q_i = kb \, \Delta t / (e^{by1} - 1)$$

The difference between Q, and Q; is caused by the sensible heat of the diffusing vapors. Also,

$$y_1 h_q = k \tag{10}$$

In this equation, h, is the normal heat transfer coefficient, not corrected for the sensible heat transferred by the diffusing vapors.

If we substitute this value for k into Eq.'s (8) and (9), and let by, $= \varepsilon$, we get

$$Q_g = h_g \, \Delta t(\epsilon e^{\epsilon})/(e^{\epsilon} - 1) \qquad (11)$$

$$Q_i = h_g \Delta t(\epsilon)/(e^{\epsilon} - 1)$$

Finally,

$$h_{gg} = h_g \epsilon e^{\epsilon}/(3^{\epsilon} - 1)$$

$$h_{gi} = h_g \epsilon / (e^{\epsilon} - 1) \tag{14}$$

 $\cdot(12)$

In these equations

$$\epsilon = by_1 = w_r y_1/k$$

= $w_r/h_g = k_g \Delta p c_v/h_g$ (15)

Introducing Chilton and Colburn's analogy for heat and mass transfer,

Nomenclature

b
$$w_r/k$$
, ft.
c, c_s Specific heat at constant pressure
vapor-gas mixture, vapor, Btu./

Btu./hr.-ft.-°F.

$$k_g$$
 Mass transfer coefficient for gas film, lb./hr.-sq. ft.-atm.

$$\Delta p = p_i - p_i$$
, atm.

$$\Delta t$$
 $t_i - t_g$, °F.

V Tower volume, cu. ft.

w, Heat transfer coefficient for sensible heat transferred by the

w, Heat transfer coefficient for sensible heat transferred by the diffusing vapors =
$$k_g \Delta p c_v$$
, Bru./hr.sq. ft.°F.

$$\frac{k_g}{h_g} = \frac{M_v}{cM_m p_{ef}} \cdot \left(\frac{c\rho D_v}{k}\right)^{1/\delta} \quad (16)$$

$$\epsilon = \frac{c_v M_v}{c M_m} \cdot \left(\frac{c \rho D_v}{k} \right)^{2/3} \cdot \ln \frac{(P - p_v)}{(P - p_i)} \quad (17)$$

It should be understood that Eq.'s (13) and (14) for the apparent heat transfer coefficient have general validity for all processes involving simultaneous heat and mass transfer through the stagnant film of a nondiffusing inert gas. This situation is encountered in cooling towers, cooler-condensers, humidification and dehumidification equipment and dryers.

If we want to make allowance for the influence of diffusion on the temperature and partial vapor pressure of a gas-vapor mixture subjected to simultaneous heat and mass transfer in the same field, we should not use h, in the derivation of Eq. (1). Instead we should use the value of the corrected heat transfer coefficient, hee. If this is done, the corrected form will be

$$dp/dt = \frac{\Delta p/\Delta t \cdot (P - p_v)/p_{vf}}{(c\rho D_v/k)^{2/3} \cdot (e^e - 1)/\epsilon e^e} (18)$$

By substituting ε from Eq. (17) into

Eq. (18) we get an equation that is sometimes easier to handle

$$dp/dt = \Delta p/\Delta t \cdot (P - p_v)/\Delta p \cdot cM_m/c_vM_v \cdot (e^e - 1)/e^e \quad (19)$$

Eq. (13) can also be written as fol-

$$h_{gg} = h_g + h_g \epsilon \left(\frac{e^{\epsilon}}{e^{\epsilon} - 1} - \frac{1}{\epsilon} \right)$$
 (20)

$$h_{gg} = h_g + k_g \Delta p c_0 \left(\frac{\delta^4}{\delta^4 - 1} - \frac{1}{\epsilon} \right)$$
 (21)

If Eq. (21) is used for the derivation of dp/dt instead of Eq. (13), we get, $dt/dp = \Delta t/\Delta p \cdot 1/(P - p_v) \cdot$

$$\left[P_{gf} \left(\frac{k}{c \rho D_{\Psi}} \right)^{2/3} + H_1 \Delta p \frac{c_{\Psi} M_{\Psi}}{c M_m} \right] (22)$$

In this equation we define H_1 as

$$H_1 = [e^{\epsilon}/(e^{\epsilon} - 1)] - 1/\epsilon$$
 (23)

Eq. (21) shows more clearly the influence of the sensible heat of the diffusing vapors on the heat transfer coefficient. For when & goes to zero, $H_1 = 0.50$. And this value for H_1 may be used as an approximation for small values of E.

This means that we can use Eq. (1) or its corrected forms-Eq.'s (18), (19) and (22)—to determine the intermediate points in a gas-cooling tower.

APPLICATION TO ACTUAL DESIGN

For the design of a cooling tower, the temperature and vapor pressure of the entering cooling liquid and hot gases are usually known or assumed. The choice of the outlet temperature of the cooling liquid can not be made independently because it may be limited by the wet-bulb temperature of the entering gases. But once this outlet temperature is fixed, we are free to select a proper ratio between the flow of liquid and gas, L/G. Then the outlet temperature for the gases can be calculated from a heat balance.

If we select the outlet temperature for the gases first, the value L/G can be calculated from a heat balance in the same way. Proper account must be made for the heat content of the vapor entering and leaving the tower with the gases. If the vapor pressure of the gases leaving the tower is greater or less than that of the entering gases, the flow ratio L/G will not have the same value at the top and bottom of the tower.

We can follow the behavior of the gas in the tower by carrying out a graphical step-by-step procedure on a temperature-partial vapor pressure diagram (see cut). The best way is to start at the hot end of the tower. If we assume that point Λ represents the condition of the entering hot gases and point A' the condition of the leaving cooling liquid in a countercurrent gas-cooling tower, the slope of the line AA' represents the quotient of the driving forces for mass transfer and heat transfer, $\Delta p/\Delta t$.

By applying one of Eq.'s (1), (18), (19) or (22) we can calculate the rate dp/dt representing the initial trend in the change of the entering gas-vapor mixture due to its contact with the cooling medium. Thus, if a line with slope equal to dp/dt is drawn through point A, the line may be followed over a short distance. This gives us point B.

Next, the difference in heat content between points A and B can be calculated, reading the temperature and partial vapor pressure for point B from the graph. This assumes that a proper basis has been selected for

zero heat content-preferably the temperature of the entering cooling liquid. The difference in heat content between the points A and B must have been transferred to the cooling liquid. Then, since we know the ratio L/G, the change in temperature in the cooling liquid over the range AB can be calculated. This gives us point B' on the vapor pressure curve. The same procedure can be repeated giving points C and C'.

In this way the path of the gasin respect to its temperature and partial vapor pressure-can be followed from the bottom to the top of the tower. The number of intermediate steps required depends upon the curvature of the line obtained and on the degree of exactness required for the design. Usually 15 to 20 points will be sufficient.

Very often the plotting procedure is quite simple especially when $dp/dt = \Delta p/\Delta t$. We will show this later in an example. The heat content calculations are easy to carry out and don't consume too much time. The final result of this type of calculation is an interesting temperaturepartial vapor pressure curve for the cooling tower showing exactly where humidification stops and where humidification begins. The curve so constructed will greatly increase your understanding of the characteristics of hot gas-cooling towers and their behavior under varying conditions.

As soon as the temperature-partial vapor pressure curve for the tower has been obtained, driving forces for both heat and mass transfer can be easily calculated for intermediate points. The surface area in packed towers required for cooling the gases is obtained by graphical integration of the equation

$$A = \int dA = G_* \int \frac{dq}{h_{gg} \Delta t} \quad (24)$$

$$A = \int dA = G_{\bullet} \int \frac{dH}{k_{\bullet} \Delta p} \qquad (25)$$

Which equation is used has no influence on the final result because the graphical operations were carried out considering simultaneous heat and mass transfer. In Eq. (24) the heat transfer coefficient may be replaced by the uncorrected coefficient, he, in many cases. Usually the total gas mass velocity does not change greatly in cooling towers and then the procedure may often be simplified by taking the heat and mass transfer coefficient as constants in front of the integral signs in Eq.'s (24) and (25).

For carrying out the graphical integration, values of q or H should be plotted against values of $1/h_{gg}$ Δt or 1/k, Δp , respectively. The area between the curve so obtained and the zero ordinate is equal to A, the required packing surface for the tower. If instead of h, or k, the corresponding volumetric coefficients, ha or ka, are used, A should be replaced by V.

Eq. (25) is sometimes easier to handle because values of H, the mass transfer to the gas, are run out during the construction of the temperaturepartial vapor pressure curve for the tower while values of q must be calculated separately. However, Eq. (25) gives a more complicated curve because the value of dH is positive during humidification and negative during dehumidification. On the other hand, the value dq is usually negative from the bottom to the top of the

Whatever the final shapes of the integration curves may be, it is evident that the total area under the curve from the zero ordinate must be measured or calculated for the solution of Eq. (24) or (25).

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In an early issue we will present a completely worked out design example showing you exactly how to use this new method.—Editor

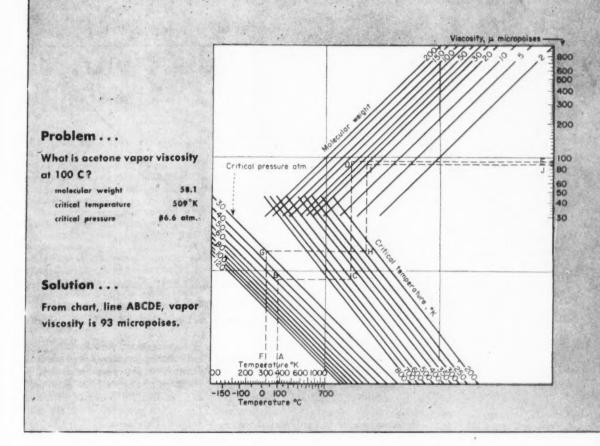


Chart for Getting Vapor Viscosities

If you know the vapor temperature, molecular weight, critical temperature and pressure, you can easily get viscosity from this chart.

A. I. JOHNSON, CHEN-JUNG HUANG and J. D. KEMP

One of the more difficult properties of vapors to evaluate—and to find in the literature—is viscosity. Yet this

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and J. D. Kemp are graduate students

property is of great importance in heat transfer and mass transfer correlations.

The most useful method presented to date involves the use of the reduced viscosity chart of Uyehara and Watson. This is a correlation of the reduced viscosity μ_r , against reduced temperature T_r and reduced pressure P_r . The critical viscosity may be estimated by the use of the equation of Licht and Stechert.

 $\mu_e = 7.70 \ (M)^{6.5} (P_e^{2/3}/T_e^{1/4}) \ \text{micropoises}$

How Correlation Was Developed

Inspection of the generalized plot of Uyehara and Watson indicates that when the reduced pressure is less than unity, covering most gas phase problems, the reduced viscosity varies exponentially as T_r . Combining this observation with Eq. (1) above, resulted in an equation suggesting that the group

 $\mu T_{a}/M^{0.5}P_{a}^{0.66}$

be plotted against the absolute temperature T on log-log paper. The result

at Toronto. Two articles, one by Dr. Johnson and Mr. Huang, and another by Huang have appeared in Chemical Engineering: Feb. '54,p.204 (Conductivity Chart) and Aug. '51,p.

118 (Absorption).

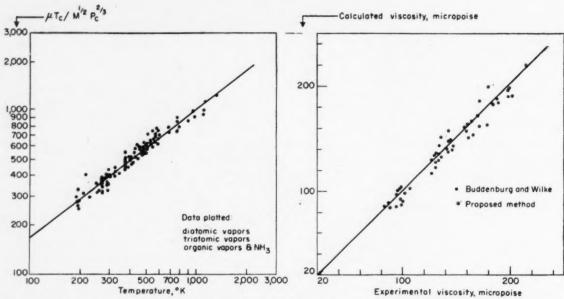


Fig. 1-Correlation of vapor viscosities at moderate pressure. Fig. 2-Comparison of viscosity correlations for gas mixtures.

of plotting 131 points for 31 compounds^{8,6} is shown on Fig. 1. From the best straight line through the points, the equation proposed in this article for estimating vapor viscosity is

$$\mu = 4.53 \ (M)^{0.5} (P_e^{2/3}/T_c) T^{0.782}$$
 micropoises

Viscosities for all the points shown on Fig. 1 were calculated and the average deviation from tabulated values was found to be 5.06%. The following vapors did not agree well with Eq. (2): water, hydrogen, helium, bromine, methanol and neon.

Line Chart for Viscosities

The line chart shown was constructed for the use of the above equation. Line ABCDE shows a sample calculation of the viscosity of acetone vapor at 100C. Acetone has a molecular weight of 58.1, a critical temperature of 509°K. and a critical pressure equal to 46.6 atm. The value read from the chart is 93 micropoises, compared to a tabulated value of 94.3 micropoises.

NOMENCLATURE

molecular weight

viscosity, micropoises (=10-4 centipoise)

critical viscosity, micropoises

reduced viscosity

critical pressure, atm.

reduced pressure T temperature, ° K.

critical temperature, ° K. T.

reduced temperature

Viscosities of Vapor Mixtures

By using pseudocritical conditions and the average molecular weight, the chart can be used directly to yield viscosities of mixtures. Of seven systems investigated by Buddenburg and Wilkie1 the method worked well except for mixtures involving carbon dioxide. Although the equation does not work well for hydrogen alone, it can be used for hydrogen mixtures. Fig. 2 compares observed and calculated values. Although the proposed chart is not as accurate as the method of Buddenburg and Wilkie it is much easier to use as shown in the following example:

Calculate the viscosity of a mixture containing 37% by volume (or mole%) hydrogen and propane at 25C. The molecular weight, critical temperatures and critical pressures of hydrogen and propane are 2, 33.2°K., 12.8 atm. and 44, 370°K., and 42.0 atm. respectively. For this mixture

 $\begin{array}{l} M\!=\!0.37\!\times\!2\!+\!0.63\!\times\!44\!=\!28.9\\ T_e\!=\!0.37\!\times\!33.3\!+\!0.63\!\times\!370\!=\!245.3~^\circ\text{K.}\\ P_e\!=\!0.37\!\times\!12.8\!+\!0.63\!\times\!42.0\!=\!31.2~\text{atm.} \end{array}$

By the line FGHII the calculated viscosity of the mixture is 88 micropoises. The observed viscosity is 87.4 micropoises.

Not a Cure-All

To sum up: a line chart is proposed for estimating viscosities of single component vapors and mixtures

of vapors, based on a knowledge of critical temperature and pressure. The chart, based on experimental data in the range of 175° to 1,400°K., should not be used for pressures exceeding the critical pressure, where the generalized correlation of Uyehara and Watson give more accurate results and should be used.

The chart should not be used for water, hydrogen, helium, and bromine, for which Uyehara and Watson's chart also is not recommended. In addition the two compounds methanol and neon gave poor agreement in this correlation.

Since specific heats of vapors may be calculated accurately by the Dobratz method,* the chart proposed in this article facilitates the estimation of thermal conductivities of vapors by the recent line chart of Johnson and Huang.

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Chemical Engineering Fundamentals

Catalysis and Adsorption—II

THOMAS E. CORRIGAN, Research Engr., Olin Mathleson Chemical Corp., Brandenburg, Ky.

Last month (Chem. Eng., Nov. 1954, p. 236) we discussed the importance of adsorption in catalysis and introduced the two well-known adsorption equations—those of Landmuir and Freundlich. This month we shall show how they are related to a more general equation and how to evaluate the constants of the general equation.

In addition to explaining the method for evaluating the adsorption constants, we are including a completely worked out example showing the method in use. Also, we'll discuss the relation of the general adsorption equations to catalytic kinetics.

Adsorption Reactions

The adsorption reaction may not always be so simple as indicated by the equation

$$A + l \rightleftharpoons Al$$

The catalytic cracking of hydrocarbons, for instance, is evidence that dissociation can occur simultaneously with adsorption. When isopropyl benzene is adsorbed on a cracking catalyst at high temperatures, it will dissociate into benzene and propylene. This is an example of a reaction that is a direct result of the tendency of adsorbate molecules to dissociate. However, in this case the compound remains dissociated even after adsorption occurs.

It has been shown that hydrogen dissociates when chemically adsorbed on a nickel surface. Here the hydrogen atoms recombine upon desorption. Dissociation, association or other complications are possible during adsorption, but upon desorption the original adsorbate molecules are formed and the adsorbate is desorbed without apparent change.

Since we can not observe the actual state of a substance in the adsorbed condition, there is no way of finding directly just what chemical change may have taken place on the surface. This is especially true where the adsorbate returns to its original form upon desorption.

In the cases where the adsorbate is desorbed in a different chemical form from that in which it was adsorbed, as in the case of isopropyl benzene, we refer

to the process as catalytic and the adsorbent is called a catalyst.

Possible Adsorption Reactions

Various adsorption reactions may occur. Here are some possibilities:

1. Langmuir type-

$$A + l \Rightarrow Al$$

2. Dissociation-

$$A_2 + 2l \rightleftharpoons 2Al$$

 $A + 2l \rightleftharpoons Rl + Sl$

3. Association-

$$2A + l \rightleftharpoons A_2l$$

4. Adsorption on two active centers-

$$A + 2l \rightleftharpoons Al_2$$

$$A + l_2 \rightleftharpoons Al_2$$

Additional complications that might arise are:

- 5. Adsorption of a large molecule on one site with consequent blocking of adjacent sites.
 - 6. Combinations of the above cases.

In the development of the equilibrium adsorption equations for any of the above cases it is not necessary to consider the steps by which the adsorption reaction occurs. Because we are concerned only with equilibrium conditions. Therefore, the mechanism has no effect on the final form of the adsorption equation.

Derivation of Other Adsorption Equations

Where a diatomic molecule dissociates upon adsorption, the equation for the adsorption reaction is

$$A_2 + 2l \rightleftharpoons 2Al$$

The equilibrium equation for this reaction is

$$K = c_{Al^2}/c_{l^2}p_{A2}$$

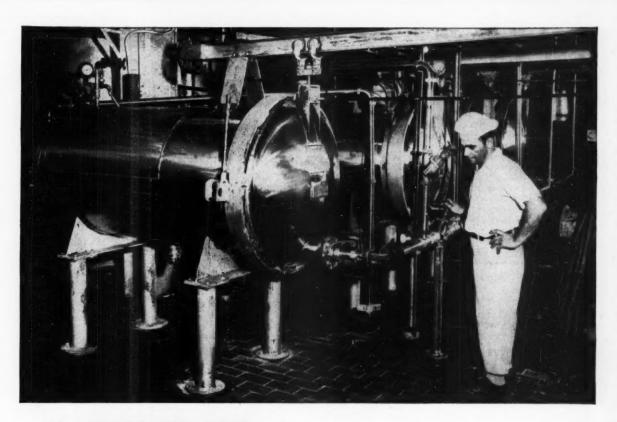
And if no other gas is being adsorbed simultaneously,

$$L = c_{Al} + c_l$$

Eliminating c, from the two equations above gives,

$$c_{Al} = l\sqrt{Kp_{A2}}/(1+\sqrt{Kp_{A2}})$$

Since A, and not A is the original compound being



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Nomenclature (Consistent units)

a, b	Empirical constants
A, A, B	Reactants
CA	Concentration of adsorbed gas
$\triangle H^{\circ}$	Heat of reaction in some specified state
K	Equilibrium constant
K'	A constant related to K
1	An active center
L	Total effective concentration of active centers
L'	A constant related to L
n	A fraction (usually between zero and one)
PA	Equilibrium partial pressure of adsorbent gas
R	Universal gas constant
R, S	Products
△5°	Entropy change in some specified state
T	Absolute temperature, deg. K. or deg. R.

adsorbed, the equation is usually expressed in terms of the formula of the molecule that exists in the gas phase (A_s in this case). And since $c_{4s} = \frac{1}{2} c_{Ai}$, the final form of the adsorption isotherm is given by this equation:

$$e_{A2} = \frac{1}{2}L\sqrt{Kp_{A2}}/(1+\sqrt{Kp_{A2}}) \tag{1}$$

Unsymmetrical Dissociation

It's possible that molecule A may dissociate into two unsymmetrical parts, R and S, upon adsorption. As long as R and S recombine to form A in the desorption process, this is still considered to be a case of adsorption and not chemical reaction. The equation is:

$$A + 2l \rightleftharpoons Rl + Sl$$

and the equilibrium expression,

$$K = c_{Rl}c_{Sl}/c_l^3p_A$$

But from the equation

$$A + 2l \rightleftharpoons Rl + Sl$$

$$c_{Rl} = c_{Sl}$$

If we let c_{A1} represent the apparent concentration of adsorbed Λ as measured by the disappearance of Λ from the gas phase, then $c_{A1} = c_{B1} = c_{B1}$. Therefore,

$$K = c_{Al^2}/c_l^2 p_A \tag{2}$$

and

$$L = c_l + c_{Rl} + c_{Sl} = c_l + 2c_{Al} \tag{3}$$

Elimination of c₁ between Eqs. (2) and (3) and solving for c₄₁ gives

$$c_{Al} = L\sqrt{Kp_A}/(1 + 2\sqrt{Kp_A})$$
 (4)

Note that Eq. (4) is very similar to the equation for symmetrical dissociation, Eq. (1).

We can write similar equations for an endless number of adsorption reactions involving dissociation, association, partial dissociation, adsorption on more than one active center and many others. All of the equations will be of a form similar to Eq. (4) provided the chemical equation is written so that the sums of the coefficients of 1 on both sides of the equation are equal. For example, in the following equations the sums of the coefficients are equal:

$$A + l \rightleftharpoons Al$$

$$A_2 + 2l \rightleftharpoons 2Al$$

$$A + 2l \rightleftharpoons Rl + Sl$$

but in the equation

$$A + 2l \rightleftharpoons Al_2$$

the sums of the coefficients of 1 are not equal. A similar derivation of the adsorption isotherm for this equation is more complicated.

If the equation were written

$$A + l_2 \rightleftharpoons A l_2$$
 (5)

the expression

$$c_A = \frac{1}{2}LKp_A/(1+Kp_A) \tag{6}$$

results. This is equivalent to

$$c_A = abp_A/(1 + bp_A)$$

and is in reality Langmuir's equation. Thus, Eq. (5) is in effect the same as

$$A + l \rightleftharpoons Al$$

and the term l, has no physical significance.

If the adsorbate were associated upon adsorption, the adsorption reaction would be

$$2A + l \Rightarrow A_2l$$

and the corresponding adsorption equation would be:

$$c_{A2}l = LKp_{A^2}/(1 + Kp_{A^2})$$
 (7)

The Basic Equation

The equilibrium adsorption equations for a single substance can be written in general terms.¹

$$c_A = L'K'p_{A^n}/(1 + K'p_{A^n})$$
 (8)

where L' and K' are constants related to K and L and where n is an exponent which may be fractional, one or greater than one. The special case where n equals 1.0 is the Langmuir isotherm.

If the value of K' is small (as in the case where the gas is only weakly adsorbed) or if the partial pressure of the adsorbate is very low, the term $K'p_A^n$ in the denominator of Eq. (8) becomes insignificant and Eq. (8) reduces to $c_A = L'K'p_A^n$, which is the Freundlich adsorption equation.

We see that both the Langmuir equation and the Freundlich adsorption equation are special cases of the more general adsorption equation, Eq. (8).

Equations Involving Two or More Gases

Let's consider the case where A is being adsorbed in the presence of another gas B. Suppose the adsorption reaction were the simple one below

$$A + l \rightleftharpoons Al$$

and

$$K = c_{Al}/p_A c_l$$
$$c_A = K_A p_A c_l$$

However, at equilibrium the adsorbent will be saturated with B as well as with A. Therefore, assuming the adsorption reaction for B is

$$B + l \Longrightarrow Bl$$



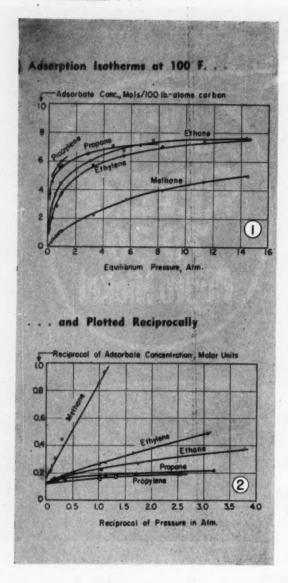
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the new expression for total effective concentration of active centers is

$$L = c_l + c_{Al} + c_{Bl}$$

$$L = c_l + K_A p_A c_l + K_B p_B c_l$$

or

$$c_1 = L/(1 + K_A p - + K_B p_B)$$

Since $c_4 = K_4 p_4 c_4$ and substituting for c_4 , the equation becomes

$$c_A = LK_A p_A / (1 + K_A p_A + K_B p_B) \tag{9}$$

Now if B were inert to the absorbent, the value of K_n would be small and Eq. (9) would reduce to the Langmuir isotherm (see Chem. Eng., Nov. 1954, p. 242).

Even if the value of K, were not insignificantly

small but if the experimental data were obtained in a system rich in B—so that the partial pressure of B remained relatively constant over the experimental range—the data would appear to follow Langmuir's isotherm. In both of the above cases Eq. (9) would be the rigorous equation and the Langmuir isotherm would be an approximation.

Inspection of Eq. (9) shows that when more than one gas is present there is an interaction, even for the most simple case. Therefore, the adsorption of a single component from a mixture of gases may not necessarily be predicted from experimental data on the pure gas alone.

However, the adsorption of any component of a mixture may be predicted if adsorption data on each of the components in the pure state is available, so that the proper adsorption reaction and the individual K values are known for each. The use of logic similar to that employed for the case of a single gas would lead to the following general equation for the adsorption of gas A from a multicomponent mixture:

$$c_A = \frac{L'K'p_A{}^n}{(1 + K'Ap_A{}^n + K'Bp_A{}^m + K'cp_C{}^q \cdot \cdot \cdot)}$$

How to Verify the Equations

Proper experimental verification of these equations would lie in the measurement of L and K. It should be possible to determine the value of L from surface area measurements and the geometric arrangement of the adsorbent. From the free energy of the adsorption data at a given temperature it should be possible to determine the value of K, the equilibrium constant. The value of the exponent n would come from a knowledge of the type of reactions occurring.

These measurements can not be made by present experimental methods. An empirical method for indirectly determining the constants L', K' and n has been developed by Koble. Determination of the constant's by Koble's method can provide some verification to the theory of chemisorption.

It can be shown, at least, that the constants behave as they should according to the theory. Since K is an equilibrium constant, it can be correlated with temperature according to the equation

$$\ln K = - (\Delta H^{\circ}/RT) + (\Delta S^{\circ}/R)$$

Application of Adsorption Equations

These equations of chemisorption are particularly applicable to the theory of catalytic reaction kinetics in which the concept of adsorption on active centers plays an important part. Since one of the steps in the catalyzed chemical reaction is adsorption and another is desorption, a previous knowledge of the true adsorption reaction and of the value of the adsorption constants would be of great help in determining the mechanism of a catalytic reaction.

Some of the constants required for these catalytic rate equations should be obtainable from the funda-

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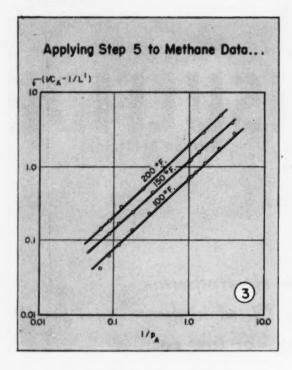
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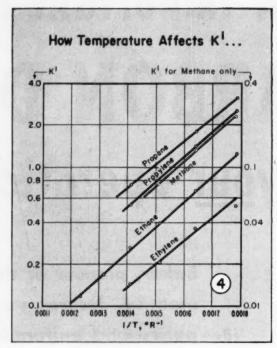
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mental equilibrium adsorption data obtained on the separate reactants. This would be a good step toward ascertaining all the constants of the rate equation for the reaction.

How to Determine Adsorption Constants

A method for evaluating the constants K', L' and n of the general adsorption equation,

$$c_A = L'K'p_A{}^\mathrm{a}/(1+K'p_A{}^\mathrm{a})$$

has been developed by Koble. His method applies to the case of chemisorption of a single component. Application of the method to data on the adsorption of methane, ethane, propane, ethylene and propylene on activated carbon showed that of these hydrocarbons only methane followed Langmuir's equation (see Fig. 1). The others were found to follow the general equation but not the special case represented by Langmuir's.

The evaluation procedure may be summarized briefly as follows:

1. The equation $c_4 = L'K'p_4^*/(1 + K'p_4^*)$ is used to give $1/c_4 = (1 + K'p_4^*)/L'K'p_4^*$ or $1/c_4$ equals $(1/L'K'p_4^*) + (1/L')$. This may be written

$$(1/c_A) - (1/L') = (1/L'K')(1/p_A)^n$$

2. Put the equation in logarithmic form.

$$\log \{(1/c_A) - (1/L')\} = n \log (1/p_A) + \log (1/L'K')$$

Thus a plot of $(1/c_A) - (1/L')$ vs. $1/p_A$ on log-log paper will be a straight line. But this plot can not be made directly because L' is not yet known.

3. Make a preliminary plot of 1/c₄ vs. 1/p₄ on rectangular coordinate graph paper and extrapolate

the curve to zero (see Fig. 2). The value of the coordinate at $1/p_A = 0$ is 1/L'. The value of L' obtained this way may not be accurate because of experimental errors in the data. It is imperative that the value of L' be known accurately. If not, at high values of c_A , there could be a large error in evaluating the term $(1/c_A) - (1/L')$. Therefore, the preliminary value of L' should be corrected.

4. If the value of 1/L' obtained from extrapolation is inaccurate, the plot of $(1/c_A) - (1/L')$ on log-log paper will show a curvature. The correct value of L' is the one that gives a straight line. Thus, the preliminary value of 1/L' can be corrected so that the log-log plot shows no curvature. This can be done by trial and error; the correction in the value of L' will be only about 3 or 4%.

5. Plot $(1/c_4) - (1/L')$ vs. $1/p_4$ on log-log paper using the corrected value of L'. Determine the value of n and 1/L'K' from the slope and intercept of this line (see Fig. 3). From the equation

$$\log \left[(1/c_A) - (1/L') \right] = n \log (1/p_A) + \log (1/L'K')$$

we can see that the slope of the line is n and the intercept is 1/L'K'.

The fundamental constants L and K can be determined only after the correct adsorption reaction is known. Once the values of L', K' and n are known it is not difficult to determine the correct adsorption reaction equation.

The quantity L' is related to L and is usually L multiplied by some constant. This constant may in part result from the transformation of the equation from

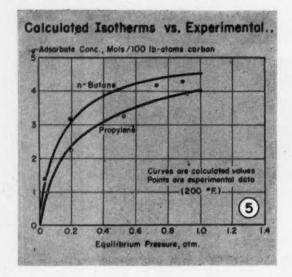


CAPE HENRY LICET, located on the south side of the entrance to Chesapeake Bay, was the first lighthouse to be built by the United States. The octogonal tower of sandstone, 129 feet high, was constructed of materials gathered while Virginia was still a colony. This original structure still stands, though it was damaged during the Civil War and is no longer in use. It was replaced in 1881 by the present lighthouse, a cast from tower 167 feet high, located 337 feet to the northeast.

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the specific to the general form. Thus the equation $e_A = L\sqrt{Kp_A}/(1+2\sqrt{Kp_A})$

when transformed to

$$c_A = L' K' p_{A^n} / (1 + K' p_{A^n})$$

requires that $K' = 2\sqrt{K}$ and that L' = L/2. In some cases even L itself may not represent all the active centers that possess affinity for the adsorbate.

In the case where a large molecule would cover more than one active center when adsorbed, the value of L in the equation would represent only the effective concentration of active centers.

Since the general equation of the form $c_A = L'K'p_A"/(1 + K'p_A")$ represents a multitude of equations with various values of constants and exponents that can be written for the postulated adsorption reactions, this equation may express a wide range of equilibrium adsorption data. The table below contains some of these reactions and their corresponding equations along with the relationships for L' and K' in terms of the fundamental constants L and K.

If a given adsorption isotherm of a certain com-

pound is expressed by one of these equations, we can determine an adsorption reaction that can be included as a step in the mechanism of a catalytic reaction involving this compound. Of course, this is a direct aid in determining adsorption constants in the reaction rate equation.

Since these equations are expressions for the phenomenon of chemisorption rather than for physical adsorption, the data should be taken under conditions at which chemisorption would be most likely to occur. However, the expression of physical data by this type of equation is not necessarily excluded since we have already shown (Chem. Eng., Nov. 1954, p. 244) that the Langmuir isotherm does in fact express both physical and chemical adsorption in many cases.

An Example of the Method

Let's work out a specific example applying Koble's method of evaluating the constants of the adsorption equations and determining the chemisorption reaction.' We'll apply the method to adsorption data for hydrocarbons on active carbon reported by Ray and Box.' They give data for methane, ethane, propane, butane, ethylene, propylene and others over a wide range of temperature and pressure.

In Fig. 1, the data of Ray and Box are plotted up as adsorbate concentration c_4 vs. partial pressure p_4 . The plot of $1/c_4$ vs. $1/p_4$ discussed in step 3 of Koble's procedure is shown in Fig. 2. The intercept for each hydrocarbon is the preliminary value of 1/L'.

Fig. 3 is an example of a plot of $(1/c_A) - (1/L')$ vs. $1/p_A$ according to step 5 of the procedure. The slope of the lines gives the value of n for methane. The intercept can be used to determine the value 1/L'K'. Then 1/L'K' can be determined.

 $\log (1/c_4) - (1/L') = n \log (1/p_4) + \log (1/L'K')$ When $1/p_4 = 1.0$, $\log 1/p_4 = 0$ and $\log [(1/c_4) - (1/L')] = \log (1/L'K')$, or $(1/c_4) - (1/L') = 1/L'K'$.

For ethane at 100 F. and at $1/p_A$ equal to 1.0, we can solve as follows:

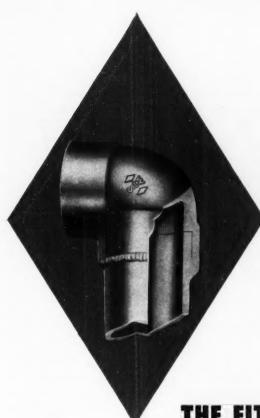
$$(1/c_A) - (1/L') = 1/L'K' = 0.1$$

Since we know L' from Fig. 1, we can calculate K'.

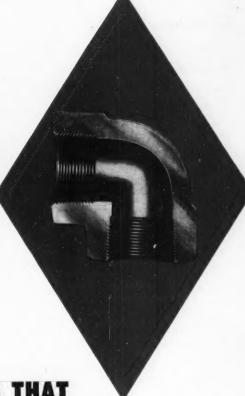
We also see from Fig. 3 that the constants n and L'

Adsorption Reactions and Their Corresponding Equilibrium Equations

		0 1			
Reaction	Equation	Adsorption Isotherm	L'	K'	n
Simple adsorption	$A + l \rightleftharpoons Al$	$c_A = L K p_A / (1 + K p_A)$	L	K	1
Adsorption with symmetrical dissociation	$A_2 + 2l \rightleftharpoons 2Al$	$c_{A2} = \frac{1}{2}L\sqrt{Kp_{A2}}/(1+\sqrt{Kp_{A2}})$	L/2	\sqrt{K}	$\frac{1}{2}$
Adsorption with non-symmetrical dissociation	$A + 2l \rightleftharpoons Rl + Sl$	$c_A = L\sqrt{Kp_A}/(1+2\sqrt{Kp_A})$	L/2	$2\sqrt{K}$	1/2
Adsorption with association	$2A + l \rightleftharpoons A_2l$	$c_A = 2L K p_A^2/(1 + K p_A^2)$	2L	K	2
Adsorption on a dual site	$A + l_2 \rightleftharpoons Al_2$	$c_A = \frac{1}{2}L K p_A/(1 + K p_A)$	L/2	K	1
Adsorption with dissociation into three parts	$A + 3l \Longrightarrow Rl + Sl + Tl$	$c_A = L\sqrt[3]{Kp_A}/(1+3\sqrt[3]{Kp_A})$	L/3	$3(K)^{1/3}$	1/3
Adsorption with dissociation, two parts alike, one different	$A + 3l \rightleftharpoons 2Rl + Sl$	$c_A = 0.63\sqrt[3]{Kp_A}/(1 + 1.89\sqrt[3]{Kp_A})$	L/3	$1.89(K)^{1/8}$	1/3



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Values of L' and n

Gas	Slope of Lines	Nearest Fraction, n	L'
Methane	1.0	1	6.25
Ethane	0.678	3/4	7.94
Propane	0.540	12	7.40
Ethylene	0.632	34	10.30
Propylene	0.569	. 12	8.94

Values of K'

Temp., °F. 100	Methane 0.228	Ethane 1.26	Propane	Ethylene 0.525	Propylene 2.54
150	0.134	0.674	1.8	0.367	1.4
200	0.077	0.40		0.206	
250		0.263	0.742	0.145	0.533
300		0.171			
350		0.119			
400	****	0.075			

Calculated Adsorption vs. Experimental

Propane at 3	00 F. $(L' = 7.4)$	n = 16, K'	= 0.565)
p4, mm.	cA, cale.	CA. expt.	Deviation, %
750	2.68	2.48	8.06
2,350	3.66	3.65	0.27
3,650	4.11	4.12	0.24
5,200	4.42	5.00	11.6
Propylene at	200 F. $(L' = 8)$	0.94, n = 16	K' = 0.83
36	0.893	0.925	3.5
154	2.41	2.22	8.55
396	3.37	3.25	3.7
699	3.96	3.91	1.28
n-Butane a	t 200 F. (L' =	5.1. n = 1. K	' = 7.8)
24	1.012	1.372	26.2
143	3.04	3.14	3.2
550	4.34	4.14	4.8
680	4.46	4.28	4.2

are independent of temperature. You may have noticed that the lines are parallel (n) is constant and that the same value of 1/L' can be used for each temperature line. The table above is a summary of the values of n and L'.

Only methane follows Langmuir's isotherm. Its adsorption reaction may be expressed

$$A + l \rightleftharpoons Al$$

Propane and propylene may be assumed to dissociate upon adsorption according to the equation

$$A + 2l \rightleftharpoons Rl + Sl$$

Ethane and ethylene appear less simple, the closest equation being

$$2A + 3l \rightleftharpoons 3A_{1/2}l$$

This indicates that two molecules would cover three active centers.

Once 1/L'K' is known from the $1/p_4 = 1.0$ intercept, K' can be calculated. The table above shows the value of K' for each hydrocarbon at each temperature. Since K' is a function of the equilibrium constant a

plot of $\log K'$ vs. 1/T should also be a straight line. Fig. 4 is such a plot for these data.

It is interesting to note that the use of the general equation has provided a means of extrapolating the adsorption data from one hydrocarbon to another.

Fig. 5 shows a curve of calculated data for normal butane. The black points are experimental values. However, no experimental data for butane were used in obtaining the calculated curve.

A comparison of calculated and experimental data for propane, propylene and normal butane is shown in the final table. For a more detailed explanation of the significance of the general adsorption equation we refer you to the original article.¹

NEXT MONTH

We'll begin discussing the kinetics of catalytic vapor phase reactions.

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How Does This Apply to Catalysis?

Adsorption studies can be made on each reactant separately. Each reactant and product can be adsorbed by itself on a catalyst to determine the correct adsorption (or desorption) reaction. When this is done the data should be obtained at or near the actual reaction conditions. Preliminary adsorption data can be obtained on the catalyst itself and at the temperature and pressure of the reaction only for those cases where more than one reactant is involved and where each reactant when alone is stable.

For a reaction of the type

$$A'' + B'' + B$$

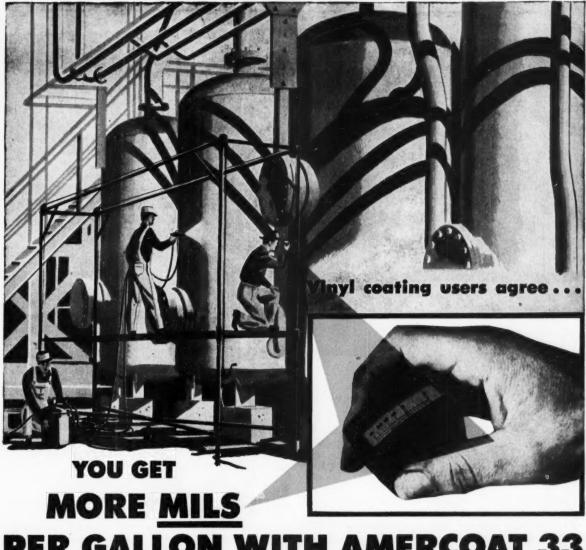
the adsorption of A, B, R and S could be studied separately. However, for a reaction such as

$$A \rightleftharpoons R + S$$

the adsorption of A on the catalyst at the temperature and pressure of the reaction could not be studied without the reaction taking place.

REFERENCES

 Koble, R. A. and T. E. Corrigan, "Adsorption Isotherms for Pure Hydrocarbons," Ind. and Eng. Chem., Vol. 44, Feb. (1952).
 Ray, G. C. and E. O. Box, Ind. and Eng. Chem. Vol. 42, p. 1315 (1950).



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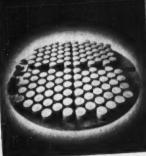
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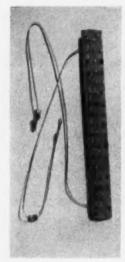
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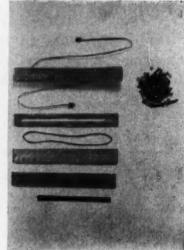
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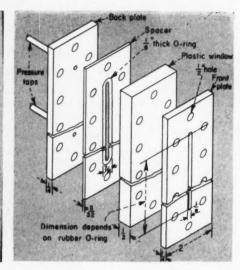
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The Plant Notebook Edited by Theodore R. Olive







* September Contest Prize Winner

O-Ring "Sandwich" Makes a Manometer for High Pressures

ROY D. PEAK, Pratt & Whitney Aircraft Div., United Aircraft Corp., Oak Ridge, Tenn.

In our work on a high-pressure process we needed to measure small differential pressures at a high ambient pressure. We bought and tried several types of instrument for this purpose which were not satisfactory. For instance, some of the tricky new pressure transducers are expensive and delicate, while manometers with level-sensing devices that make use of radiation or inductance are costly, slow acting, and not sufficiently precise. By the time I decided to design my own high-pressure manometer I had become disgusted with electronics, strain gages, inductance coils, gamma ray sources, and the like, so I designed a home-made direct-reading mercury manometer of simple and rugged construction which has been tested to 10,000 psi. and could have been designed for still higher pressures.

The several views above, from left to right, show the assembled manometer, its parts including the bolts, and an isometric sketch showing the metal parts, plastic

window and the O-ring scal. Aside from the bolts, the manometer is made from five parts: a back plate to which the pressure tap lines are secured; a spacer of \$\frac{1}{2}\cdot\text{-in.}\$ metal slightly thinner than the \$\frac{1}{2}\cdot\text{-in.}\$ rubber O-ring; an acrylic plastic sight glass (Plexiglass or Lucite); and a front plate. Both spacer and front plate are slotted. When the O-ring is laid in the slot in the spacer and squeezed between the back plate and the plastic sight glass, it forms a tight seal around the space in the slotted spacer, making a chamber for the mercury or other manometer fluid. The mercury column is easily visible through the slot in the front plate.

Such an O-ring makes an excellent scal. We use the manometer regularly for pressure of 4,000 to 6,000 psi., and have tested it to 10,000 psi. The plastic sight glass is strong and not sensitive to uneven bolt pressure.

The O-ring sight glass lends itself admirably to several types of use in high-pressure work. A single gage

★ October Contest Prize Winner.

"How to Read Your Slide Rule to One More Decimal Place."

A prize of \$50 in cash will be awarded to Royes Salmon, Process Engineering group, Union Oil Co. of California, Brea, Calif. Mr. Salmon's useful idea will be published in the January Plant Notebook.

\$50 PRIZE FOR A GOOD IDEA— Until further notice the Editors of Chemical Engineering will award \$50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

\$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional \$100 prize.

HOW TO ENTER CONTEST-Any reader of Chemical Engineering, other

than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable but non-winning articles will be published at regular space rates (\$10 minimum).

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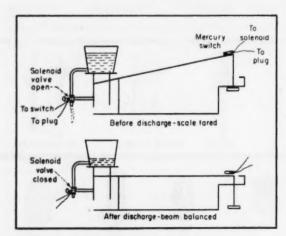
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connected to the tank above and below the liquid level serves as a level gage, or to show the color of the process liquid. A single gage connected to a differential pressure source through mercury seal pots serves well as a single-leg manometer. Two such gages connected together at the bottoms with the tops connected to a differential pressure source through mercury seal pots makes an excellent double-leg manometer.

Use of a rubber O-ring limits the instrument to 200 F., but the substitution of silicone rubber for the O-ring, and a glass window for the plastic, allows the instrument to be used at temperatures of 500 to 550 F. The O-ring seal itself is good for super pressures to 50,000 psi. Hence, an instrument of this type is useful over a remarkable range of pressure and temperature.



Easy-to-Build Liquid Cut-Off Makes Scale Automatic

Burton H. Sanders, Process Engineer, Thiokol Chemical Corp., Elkton, Md.

For laboratory or small-scale pilot operations, purchase of the commonly used electronic-controlled weighing equipment may not be economically feasible. Yet, sometimes automatic flow cut-off may be desirable even on the smallest scale, for instance, when safety calls for a remotely controlled experiment.

A simple automatic liquid-flow cut-off system can be readily set up utilizing a swinging-beam balance, for example, a 20-lb. Ohaus scale. The container for the liquid to be weighed out is provided with a bottom discharge and a solenoid valve. This valve may be supported from the container or bracketed to the scale.

A mercury switch, in series with the solenoid, is secured to the far end of the beam so that contact is made when the scale is at equilibrium, thus closing the valve and shutting off flow.

To operate, merely dump an arbitrary amount of liquid feedstock into the container, then tare the scale. During this procedure, the valve discharge is plugged, for example, with a clamp or stopper.

After taring, the weights on the scale are adjusted so that the scale will come to equilibrium again when the pretermined quantity of liquid has discharged. The plug is removed (and placed on the scale besides the container) and the addition of a weighed amount of liquid needs no further attention.

Following a large number of successful runs, these

added comments are worth noting:

1. When a mercury switch is tilted slowly, the mercury flow undergoes a short time lag. This must be considered when mounting the switch on the scale. A few experimental runs will show the correct position.

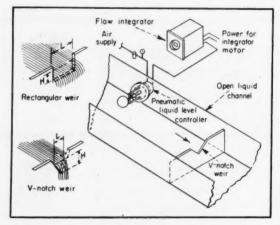
2. Scale sensitivity is decreased somewhat by the wire leads. Yet, we have been obtaining $\pm 0.5\%$ accuracy in cur automatic weighing.

With an adjustable solenoid valve or an additional hand-operated valve, flow rate may be regulated at will.

4. Any nipple or tubing on the outlet of the solenoid valve should be kept as short as possible, from the standpoint of overflow following cut-off.

The assembly costs but a fraction of standard electronic equipment.

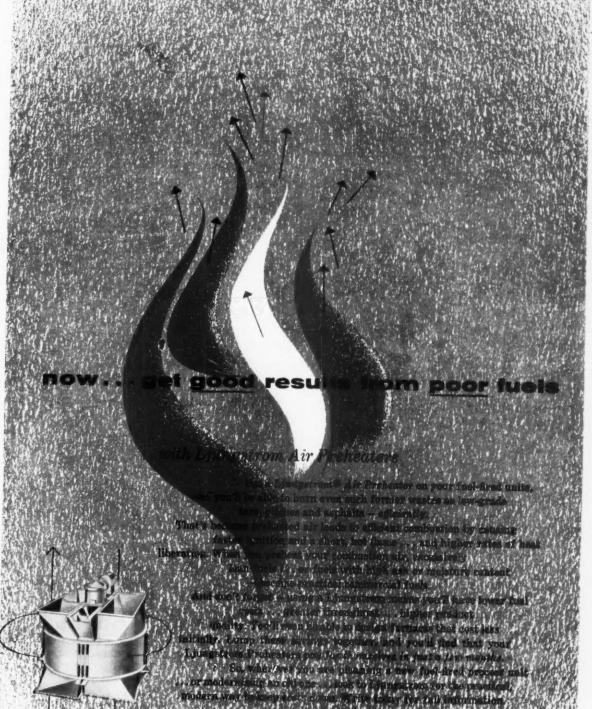
The writer wishes to thank Thiokol Chemical Corp. for the privilege of publishing this article.



Accurate Way to Measure Flow With Weirs in Open Channels

LEONARD STEBER, E. R. Squibb & Sons Div., Olin-Mathieson Chemical Corp., New Brunswick, N. J.

There are several ways to measure flow rates through open channels, including several types of weirs and flumes. All depend on putting some form of constriction in the flow path and then measuring the amount by which the level upstream of the restriction rises above the bottom of the restriction at various rates of flow. For a number of these devices there are accurately known empirical relations between restriction area, head and flow rate. Therefore it is only necessary to have an accurate method of measuring the head.

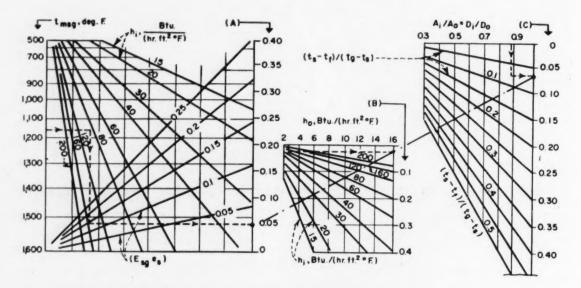


The Air Prohecter Corporation and the Comment of th

One simple way to accomplish this is with a sensitive liquid level controller with pneumatic output which can be used to actuate an indicator, recorder or integrator. If it is to be read directly in flow units, the instrument must of course be calibrated for the particular type of restriction used. For example, with a rectangular weir the flow rate Q, in cu. ft. of water per sec., is expressed by the relation 3.33 $(L-0.2H)H^{t.s}$ where L is the length of weir opening and H is the head above the weir bottom, both in feet. For V-notch weirs $Q = K(H)^{s/s}$, where K is 2.4381 for 90° notches and 1.4076 for 60° notches. The units for Q and H are as before. (Formulas from Ingersoll-Rand Co.'s "Cameron Hydraulic Data.")

The liquid level controller chosen for measuring the height of the weir crest must have sufficient sensitivity to detect changes of the magnitude to be encountered. As in the sketch it is mounted in the side of the channel several feet upstream, with the lowest point of float travel level with the bottom of the weir. If sudden liquid surges are expected or high flow rates which will cause turbulence, then the float can be housed in a nozzle long enough to shield the entire controller, or a baffle or cage upstream of the level detector can be provided to shield it.

For highest accuracy the indicator or totallizer conversion factor for converting head to volume flow rate should be determined by calibration in the field.



Quick Estimation Method for Tube Wall Temperature

Y. S. TANG, Chemical Engineer, General Chemical Div., Allied Chemical & Dye Corp., Camden, N. J.

In the convection section of a furnace or pipe still, heat is transferred by both radiation and convection. Various methods have been developed for handling the radiation calculation, but it is still necessary to

NOMENCLATURE

A Tube wall area; subscripts o, outside, i, inside tube.

 Pseudo-emissivity factor of tube wall surface as defined by McAdams.¹

 E_{ig} Emissivity factor between combustion gases and tube wall.

h Convective heat transfer coefficients; subscripts o, outside, i, inside tube.

f Temperature, ° F.; subscripts g, of combustion gas, s, of tube wall surface, and f, of fluid inside tube.

f_{maq} Arithmetic mean temperature of gas and tube wall, ° F.
T Temperature, ° R.; subscripts g, gas, and s, tube wall surface.

 T_{mag} Arithmetic mean temperature of gas and tube wall. * R. θ Stefan-Bo'tzmann constant 'n radiation equation.

estimate the tube wall temperature by trial-and-error. This is done by a heat balance at the tube wall, recognizing that the heat transferred from the combustion gases to the tube wall by radiation, plus that transferred by convection, equals that transferred from the tube wall to the contained fluid by convection, or

$$(E_{sg}e_{s}\theta)(T_{s}^{4}-T_{s}^{4})+h_{o}(t_{g}-t_{s})=(A_{i}/A_{o})h_{i}(t_{s}-t_{f}) \quad (1)$$

We can simplify the first or radiation term in this equation by using the approximation of Rohsenow et al and writing it as:

$$4 \; (E_{sg}e_s\theta) \; (T_{msg})^3 \; (t_g - t_s)$$

Eq. (1) can now be rearranged into the form:

$$4 \left(E_{sg} e_s \theta / h_i \right) \left(t_{msg} + 460 \right)^3 + \left(h_o / h_i \right) = \\ \left(A_i / A_o \right) \left(t_s - t_f \right) / \left(t_g - t_s \right)$$
(2)

The value of each term in this equation can be determined graphically at a given trial value of t, and checked by means of the simple three-part chart pre-

Case No. 105

Upjohn Company Reports:

• Estimated 90% Cost Savings

• Exact Qualitative Analysis

• Purity Regardless of Demand

Operator is shown abserving test burner at the top of the control panel for the Kemp M1HE lnert Gas Generator at Upjohn Company.

How Kemp Inert Gas Generator Provides Process Gas and Reduces Fire Protection Cost in Cortisone Plant

Regardless of the demand for inert gas—both for processing and for fire protection service —Upjohn Company, Kalamazoo, Michigan, reports that their Kemp M1HE Generator delivers exact qualitative analysis of gas at high purity.

The installation operates in their new plant, opened in 1953 to provide starting material for the Upjohn fermentation process used in manufacturing USP Cortisone—one of many fine pharmaceuticals manufactured for the ethical drug field by Upjohn.

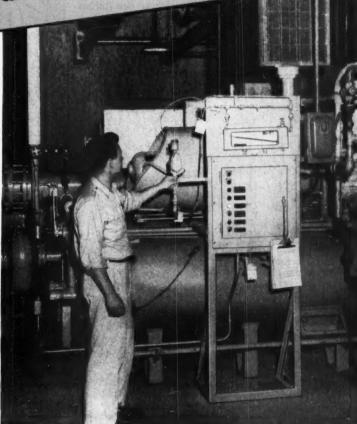
The Kemp M1HE Inert Gas Generator provides 13% carbon dioxide and 87% nitrogen, both for processing use and to replace the costly cylinder gas formerly used for fire protection. Fired by natural gas, the generator has a capacity of 8,000 cfh.

User Very Enthusiastic

Since installation of the unit, Upjohn Company estimates costs of gas have been reduced 90%... purity of the gas is constant... exact qualitative analysis is maintained up to full generator capacity.

Kemp Can Help You

If you still rely on inefficient, unsatisfactory methods of providing inert gas, let Kemp help you, too. Kemp engineers will gladly discuss your specific problems with you—without obligation, of course. So write today for complete information.



Close-up of the Kemp Industrial Carbureter, the heart of every Kemp Installation. It assures the desired analysis of inert gas under any demand without weste, without adjustments.



For more complete facts, ask for Bulletin No. 1-10. Write to: C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland.

KEMP OF BALTIMORE



INERT GAS GENERATORS

ADSORPTIVE DRYERS - SINGEING EQUIPMENT IMMERSION MELTING POTS

CARBURETORS - BURNERS - FIRE CHECKS

sented here, to make certain that the trial t, chosen fits the relationship of Eq. (2). In the chart the three sections, A, B and C represent respectively the first, second and third terms of Eq. (2). If the trial value of t, fits the equation, then the three points on Scales A, B and C will lie on a straight line. If they do not, then another trial must be made.

To see how this method works, assume the following conditions: The convection section of an oil pipe still has 3.5-in. I.D., 4.0-in. O.D. tubes, 24 ft. long, arranged on 8-in. centers with equilateral triangular pitch, in horizontal rows of six tubes. An API No. 23 oil of 26 cp. viscosity at 210 F. enters the bottom of the convection section at 420 F. and leaves the top of the section at 730 F. Flowrate is 3,600 lb./(hr. tube), with flow upward through each row in series. The flue gas from the combustion chamber is at atmospheric pressure. It flows across the tubes, entering the tube bank at the top at 1,550 F. and leaving at the bottom at 590 F. The mass velocity is 810 lb./(hr. ft.* of minimum free area). It contains 7.1% CO₂, with a H₂O:CO₄ ratio of 1.8.

We desire to find the surface temperature of the top row of tubes, t_{i} . Our first trial with $t_{i} = 820$ F. does not give a straight line through Scales A, B and C. So we try a value of $t_s = 780 \text{ F}$. Then $t_{mag} = (780 +$ 1,550)/2 = 1,165 F. and $(t_s - t_t)/(t_s - t_s) =$ (780 - 730)/(1,550 - 780) = 0.07. The ratio A_4/A_8 . $= D_i/D_o = 3.5/4.0 = 0.875$. To find the heat transfer coefficients: h, can be determined from the empirical equation of Sieder and Tate' or it can be obtained graphically from the author's earlier article.8 Properties of the film are based on the given conditions of the oil. In this case h, turns out to be 82 Btu./(hr. ft. °F.). The value of h_o can be determined from Mc-Adams' simplified equation for gases flowing normal to staggered tubes. This value is substantially constant at various t, values assumed and is found to be 2.5 Btu./ (hr. ft.º °F.). Also from McAdams' we find E.,e. = 0.15 for the given temperature and composition of the flue gases.

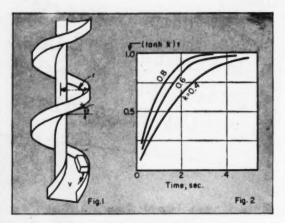
Solution—From the assumed $t_{m,s}$ of 1,165 we find the first term of the equation from the A-section of the chart (see dotted line) by following the key $t_{m,s} \rightarrow h_t$ $\rightarrow (E_{ss}e_s) \rightarrow A$. Similarly, in the B-section we locate B from the values found for h_t and h_s . Using the values for A_t/A_s and $(t_s - t_t)/(t_s - t_s)$ in the C-section we find Point C. Since these three points now align, our assumed value of t_s is correct.

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3. Rohsenow, W. M., and J. P. Hunsaker, ASME paper 46-A-53.
4. Sleder, E. N., and G. E. Tate, Ind. Eng. Chem., 28, 1429-26 (1936).
5. Tang, Y. S., Chem. Eng., 60, 174-6 (Dec. 1953).

Correction

In Jack Lowenstein's article on flow over weirs, pp. 224-6, October 1954, the charts are correct, but small errors occurred in two equations. In Eq. (1), for h (in.) read H (ft.). In Eq. (4), for $(LH)^{3.4}$ read $L(H)^{3.4}$.



How to Check Performance of Your Spiral Chutes

H. K Ku and Y. M. TAO, Respectively, Mechanical and Chemical Engineer, Taiwan Fertilizer Co., Factory 5, Hsinchu, Taiwan (Formosa), China.

During trial operation, a spiral chute in our cyanamide plant did not give smooth performance so it was decided to make an analysis of the way a chute works. The geometry of the chute (Fig. 1) shows that:

$$v = a(\tanh k)t \tag{1}$$

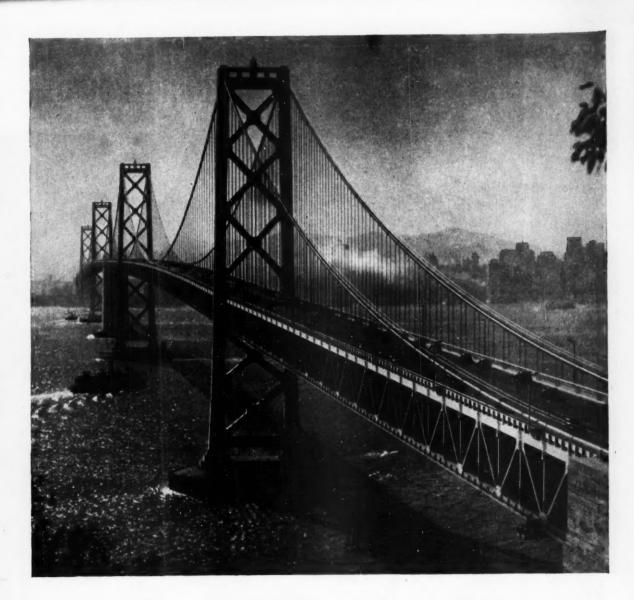
where v is the velocity of an object moving down the chute, in meters per sec. (neglecting air resistance); t is time in seconds; and a and k are constants depending on the slope and radius of the chute and the coefficient of sliding friction. Where θ is the angle of the chute with the horizontal, in degrees; g is the acceleration of gravity (9.8 m./sec.²); and μ is the coefficient of sliding friction of the moving object against the chute,

$$a = \sqrt{rg(\sin \theta - \mu \cos \theta)/\mu \cos^2 \theta}$$
 and $k = \mu a \cos^2 \theta/r$.

Plotting t vs. $(\tanh k)t$ we find that $(\tanh k)t$ approaches 1.0 as an asymptote after a few seconds travel, so that v_{wtt} , the final velocity, quickly becomes a. (See Fig. 2.)

Now, if H is the chute height in meters, again from the chute geometry we find that:

$$H=(r\sin\theta/\mu\cos^2\theta)\log_*[(\cosh k)t]$$
 (2)
As an example take $H=9.5$ m., $r=0.9$ m.; $\theta=30^\circ$; and $\mu=0.37$. Substituting in the expression for $v_{utt.}=a$, we get $a=\sqrt{0.9} \times 9.8 \times (0.5-0.37 \times 0.866)/(0.37 \times 0.866^\circ)=2.39$ m./sec. The time of descent t is readily found by trial-and-error from Eq. (2). Try $t=9$ sec. Then $H=(0.9\times0.5)/(0.37\times0.866^\circ)\times \log_*[\cosh(0.37\times2.39\times0.866^\circ)/0.9)\times 9.0]=9.63$ m. This trial result is only 0.63 m. too great and so it is clear that the travel time is around 9 sec. This analysis assumes there is no starting velocity of the sliding body. However, even if the body is started at its ultimate velocity, there will be only a small reduction in the total time of descent so that not much error results from the assumption of zero starting velocity.



16 years tells quite a story

It's the case history of how well coatings have protected the beautiful Bay Bridge, from San Francisco to Oakland. Since late 1938, with minor exceptions, maintenance coatings for the entire 16,000,000 sq. ft. of metalwork have been based on BAKELITE Phenolic Resins pigmented with aluminum.

Consider the service conditions: salt-air, fog, rain, direct and reflected sunlight, wind and vibration, heat, corrosive industrial atmosphere. There's sulphur dioxide given off by diesels. It combines with moisture

on bridge surfaces to form dilute sulphurous or sulphuric acid.

Even so, "Experience indicates an average 7-year (painting) cycle is about right." And because the war years interrupted regular schedules, "some surfaces are about 8 years overdue but not in bad shape."

Many other case histories show the excellent service you can expect from coatings based on BAKELITE Resins. For a list of suppliers, and a free copy of our booklet, "BAKELITE Resins Coatings for the Chemical Industry," write Dept. YZ-46.

Photo and data courtesy California Division of Highways,

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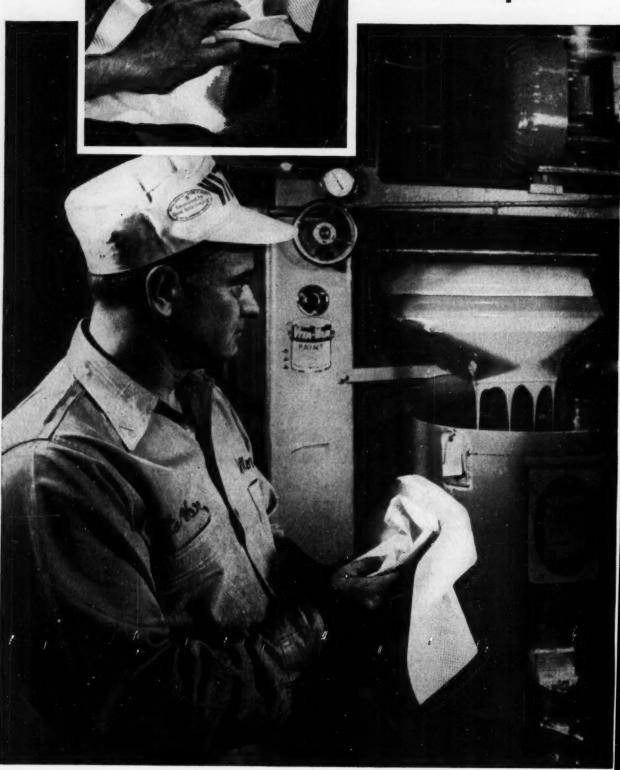


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Scott Wipers are two-ply for more strength, "Perf-embossed" for greater dirt retention. Moreover, they provide a constant source of clean, fresh wiping material. Use one thoroughly, throw it away. No more laundering, no more sorting and baling.

Compare Scott with whatever you're using now—for cost, convenience and performance.

The Scott representative or distributor in your area will be glad to help you set up a production-line demonstration in your plant. Why not call him or mail this coupon today.

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You and Your Job Edited by Hugh T. Sharp

GOING TO SCHOOL BY MAIL IS . . .

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Rapid—You pick your own course and set your own pace. Learn as quickly or as slowly as you want.

<u>Inexpensive</u>—Cost in both time and money are relatively low. No travel or lost job-time is involved.

IT MAY PAY YOU TO . . .

Take a Look at Correspondence Courses

Got your sights set on being the most "savvy" engineer in your organization? Or are you drawing a bead on one of those jobs on the upper levels of your company's organization chart? In any case, you'll stand a better chance of reaching your goal if you supplement your present engineering degree with further knowledge.

There are plenty of ways to gain the knowledge you need. In some instances a trip to the library will suffice, in others, you may find yourself faced with the need to return to school for one or more courses. If you're dismayed at the latter prospect, it may be worth your while to investigate a correspondence school course.

You'll find courses available which can help you gain a professional engineering license, give you a background in business administration and economics—essential to any management post—or which can provide specific information and training in subjects ranging from accounting to writing. And,

NEXT MONTH . . .

What is the job outlook for chemical engineers in 1955? Is shortage or surplus in view? How about salaries? The draft? Reserve calls? Engineers' unions? For a look ahead, check next month's YOU AND YOUR JOB.

since they'll come to you, you won't have to lose a minute from your regular job to take them.

Who Takes the Courses?

Current enrollment in correspondence courses in the United States runs to about a million and a half students per year. Over four-fifths of these take courses which have a direct connection to their jobs and provide grounding in the fundamentals of business, engineering or the trades.

To be sure, the majority of the students turn to schooling by mail to obtain an education they would have otherwise missed completely. However, an increasing number of engineers and business men find the correspondence schools valuable for additional training—as a rapid way to acquire the fundamentals and the vocabulary of other fields.

Today, roughly 20% of the students of one of the largest correspondence schools* have had some college training, and are now employed in industry posts. Generally, these people are out either to broaden their education and training or to gain specific knowledge in another field. For example, a man moving into management may desire to supplement his en-

gineering training with a knowledge of management operations, or a chemical engineer may need specific training in some phase of civil or electrical engineering.

Correspondence courses have even been developed for the engineer who wishes to move into sales work.

What Are the Advantages?

The convenience of home study is probably the most important factor in choosing this method of learning. Your classroom is wherever you happen to be, you study whenever it suits you and you can take whatever courses you wish.

The student can take his pick of over 400 schools (about 150 of them connected with a regular college or university) which offer home study courses. These schools give him a choice of literally hundreds of courses. Law, accounting, chemistry, engineering (including chemical engineering), business management, economics, languages, leadership, labor relations and even hobbies like photography, art and music are taught by mail.

Another important advantage of the mail order course is that you can set your own pace. A slow class won't hold you back, nor will a rapid teacher skim over material which you don't grasp right off the bat.

[•] International Correspondence Schools, Scranton, Pa.



Keeps You and the Boss Posted

The student can learn as little or as much, as quickly or as slowly as he wishes. And the school will keep him posted on his progress as the course proceeds.

In addition, most schools will also keep the student's boss informed as to his progress. This is an intangible but nonetheless important benefit. The fact that a fellow is trying to improve himself is brought directly to the boss' attention and kept before him by means of regular progress reports. In many cases this itself is a leading factor in gaining promotions.

Some companies, in fact, use correspondence courses as a part of their regular employee training programs. In most cases, these are at a subprofessional level—draftsmen, lab assistants and trade apprentices. A few, however, use them as the basis of supervisory, management and sales training programs.

In remote locations these courses often comprise the company's and the individual's entire training program.

How to Enroll

How do you go about enrolling in a correspondence course, or how do you go about finding if the course in which you're interested is given?

One way would be to answer newspaper ads. Perhaps a better way would be to contact the National Home Study Council,* an accrediting body for private correspondence schools.

This organization will give you a list of the available courses at about 40 schools along with the complete name and address of the school, and will simplify the job of selecting a good school.

If you're interested in obtaining home study courses from an extension school of a regular college or university, you can write the National University Extension Association for a similar list of courses. As might be imagined the costs of correspondence school courses vary according to the length and complexity of the course and the school giving the course. For a full-fledged course leading to a diploma, correspondence study will average about \$500 and will re-

quire about 10 hr. per week of your time.

Short courses, 5 to 10 lessons, will cost between \$25 and \$100, with the average around \$55. The investment in time is up to you. It has been estimated that an average lesson requires 12 to 17 hr. to complete.

HOW TO . . .

Keep Up With Engineering

Staying on top of a fast moving field is a big job for an individual and for a company. Here's how Dow's Texas Division keeps up with developments.

D. C. Morgan

To insure that the most up-todate engineering practices are available for its clients, the engineering department of The Dow Chemical Company's Texas Div. has developed a specialized study approach, which it calls the Current Engineering Development Program. In its two years of operation this approach has paid off in many ways—both tangible and intangible.

In operation the program is quite simple.

How It's Run

Dividing engineering into many phases, the plan requires each engineer to keep up to date on one particular subject. Normally, this subject is in the same field as the engineer's regular job. Sometimes it is not—but the plan caters as far as is practical to the individual's preferences. Effort is made to use each man's education and experience most effectively.

It is not intended to cover every possible phase of engineering. Subjects are limited to those reasonably certain to be of value to Dow, currently or in the future. Currently, about 150 subjects are covered.

DAN MORGAN is administrative assistant in the engineering department of Dow Chemical Company's Texas Div.

Mention of a few will give you an idea of its scope: Acoustical control, adsorption, batteries, cathodic protection, diffusion, filters, instrumentation, nuclear power, piping code interpretations, protective relays and fuses, soil mechanics and foundations, V-belts, waste water and sewage disposal.

The engineering department set up this plan in December, 1952. Experience of the past two years now permits evaluation of the system.

It works. Here's how:

Assembling the Information

Magazines, technical papers, textbooks, special reports, manufacturcrs literature and catalogs are the sources of most of the engineers' information. For the most economical use of time and material, the securing of all such matter is centralized in the administration section of the department.

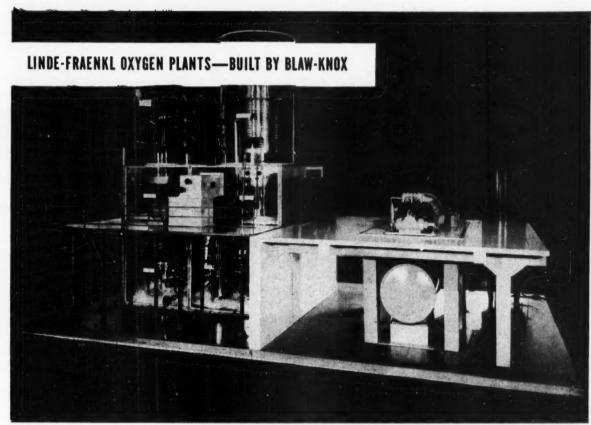
Technical periodicals are routed to engineers according to established needs of their work and their assigned subjects. Other matter is scanned and directed to attention of engineers as required.

Disseminating the Information

It is in disseminating the information gained to the rest of the company that the Current Engi-

What Are the Costs?

^{*1420} New York Ave., N. W. Washington 5, D. C. † Office of the Secretary, Bloomington, Ind.



Scale model representing a 160 ton per day pure oxygen plant now under construction by Blaw-Knox,

all oxygen-99.5% pure at the lowest total operating cost of any tonnage oxygen unit available

Recent design improvements enable new Linde-Fraenkl plants to produce *all oxygen* at 99.5 percent purity at the lowest total operating cost of any tonnage oxygen unit available.

An average power consumption of only 450 horsepower hours is required to produce one ton of 99.5 percent oxygen. Such low power consumption is the result of excellent thermodynamic design and low pressure drops throughout the plant.

Simply designed regenerative heat exchangers maintain extremely close temperature differentials between inlet air and product gases. This is very important when as much as 40 percent of the total refrigeration required can easily result from only a few degrees difference in temperature between these gases. No chemicals are necessary to remove water and carbon dioxide.

The low pressure requirements of the plant reduce the costs of compressors, drives and auxiliaries.

Because of their advanced design, compact arrangement and relatively few moving parts, Blaw-Knox-built, Linde-Fraenkl units produce more oxygen of greater purity at the lowest total operating cost of any tonnage oxygen plants available. They are ideal for production of argon as a by-product.

If you are interested in low cost tonnage production of oxygen, write for Blaw-Knox Bulletin No. 2402.



BLAW-KNOX COMPANY Chemical Plants Division

Pittsburgh 22, Pennsylvania

Chicago 1, Illinois / Tulsa 1, Oklahoma

neering Development Program has a made its mark.

By the fifteenth of each month, each man is expected to write, and submit to the administrative assistant in charge of this program, a report on the past month's developments in his field. If no outstanding developments have occurred in a particular field, that fact too is reported.

All reports are then read and evaluated. Those deemed to be of greatest general or special interest to the Dow engineers or plant personnel are condensed, submitted to the author for re-check and approval, and published in the Engineering Department Technical News Bulletin.

This monthly paper is circulated to each employee of the engineering department, and to all supervisors, from the foreman level up, in Dow's other Texas Div. departments. Copies are also distributed to a few dozen outsiders, principally college teachers, technical libraries and individuals in other Dow divisions and associated companies, who have requested the paper.

The Bulletin also furnishes copies of the engineers' reports in full text to all Dow personnel who request them. Readers who differ with the opinions expressed by the report writers are invited to have their say. And space is made available for any interesting and worthwhile information or discussion thus developed.

What Are the Results?

Benefits are definite. Some are easily counted; others are more intangible.

It's easy to recognize the value of having a designated, up-to-date specialist for each engineering subject. The building of a technical file of the best engineering practices, which are usually the consensus of top authorities, thoughtfully evaluated by the reporting engineers, can

also be appreciated. In fact, just being able to put a sales engineer in touch with the right Dow engineer for explanation of new products without waste motion is an easily recognized advantage.

Not so easily measured are some other aspects. How much study is saved in departments other than engineering? How many problems are avoided or solved because published reports of current developments on, say, welding, electrical safety hazards, materials handling, are at hand? Engineering management frankly does not know.

Judged from the number of requests received for reports, the service rendered to other departments is a paying proposition for the company. But this is not the test. Engineering management is positive that the program pays off in the engineering department alone by having at hand a recognized, qualified specialist in almost every phase of engineering.

TRANSFERS

... How Much Aid

If your company transfers you to another location how much financial help will it give you? If it's like those surveyed by the American Management Association recently, you can count on it to be fairly liberal with its financial support.

When it comes to transferring individual workers a 24 company sample indicates that 66% will pay transportation costs of one person while house-hunting; some 58% will grab the check for the wife, too. Thirty-seven percent of the companies give a per diem allowance to househunters while they search.

The employee is put on an expense account in the new town until his family arrives by all but two of the 24 companies in the sample. And 77% of these organizations will pay his fare for premoving day visits home.

However, the companies take a tighter hold on the purse strings when it comes to housing. Only 37% will reimburse the employee for money lost on an unexpired lease and only a quarter of them will reimburse him for loss incurred in selling his house. While 20% will grant direct loans for new house purchases. a mere 8% will pay the employee's rent on new housing before occupancy.

It's a brighter picture when the company itself relocates. Eight firms of a nine-company sample reimbursed employees for loss on unexpired leases.

Oh, yes, in the combined sample of 33 companies, all paid for shipment of the employees' household goods.

CONCENTRATION SPAN ... Lengthen Yours

Take a ten minute break after every fifty minutes of rigorous mental effort and you'll get more work done. That's the prescription of Dr. Walter Woodward, industrial psychiatrist with the American Cyanamid Co.

After about two hours of concentrating on a job, a person's attention wanders and his effectiveness decreases, observes Dr. Woodward. It takes some time before sufficient mental energy is recovered. In the meantime, mistakes mount and the mind is frustrated in its efforts to focus on the work at hand.

Limiting concentration to about fifty minutes and following with a ten-minute change of pace is Dr. Woodward's remedy. This routine can be repeated up to four times without tiring the worker. It actually doubles the concentration span, eliminates fatigue and attention wandering.

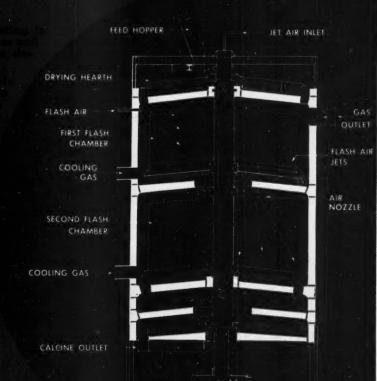
Incidentally, it isn't necessary to leave your desk for that ten-minute break. A change of pace is all that's needed.

Modern Roasting

High tonnage rate

Positive temperature control

Roaster gas rich in SO₂



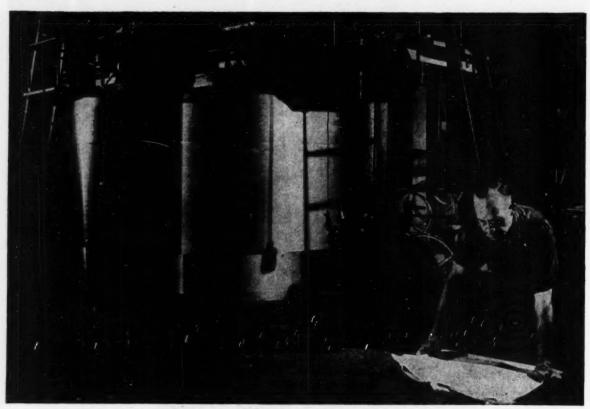
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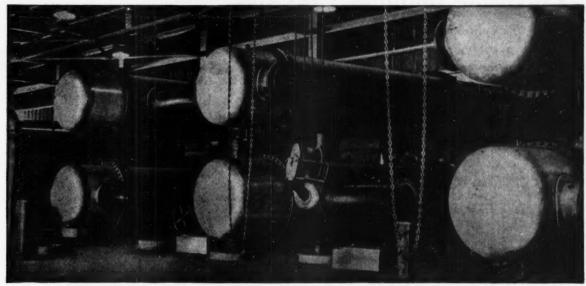
Profit-building answers to Modern

and built by Alco to meet today's demands in petroleum and petrochemical processing...results of Alco Experience...gained through many years of designing and building heavymetal equipment for refining and processing companies the world over...and Alco Facilities...capable of handling economically an extremely wide range of metal-fabricating operations...of meeting strictest customer specifications.

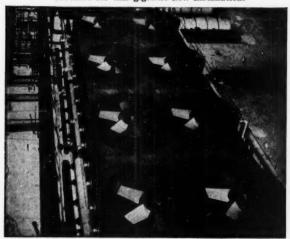


LARGE-DIAMETER BORING MILL, equipped with two rail heads and capable of handling work 25 ft 0 in. high, is typical of the complete, modern production facilities in Alco's shops which can produce virtually every type of heavy-metal equipment for the petroleum, chemical and power industries.

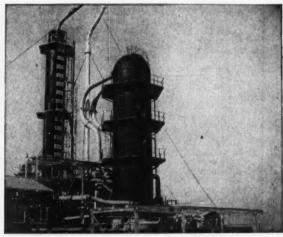
Processing problems



HEAT EXCHANGERS, built by Montreal Locomotive Works, Ltd., an Alco affiliate, ready for final piping in the Edmonton plant of The Canadian Chemical Company, Limited. Heads, tubes and tube sheets of these exchangers are fabricated of Type 316 stainless steel. MLW has supplied more than 200 heat exchangers and reboilers for this gigantic new installation.



AIR-COOLED HEAT EXCHANGERS were supplied by Alco for Celanese Corp., of America's new Pampa, Texas, plant. Mounted in 17- by 24-ft induced-draft housings, each cooling bank is equipped with two Monel fans supported on silicon rubber. Total heat dissipation from this specially engineered installation is 229,400,000 Btu per hr, a record for air-cooled condensers.



WORLD-WIDE USE of Alco equipment is typified by the wide range of Alco coolers, exchangers, condensers and heaters in service at the Aquila refinery in Trieste, Italy. Operating on Middle Eastern crudes, Aquila's annual capacity is over 900,000 tons with products including high-octane gasoline, top-quality lubricating oils and several types of asphalts and paraffin waxes.

You can find your own profit-building answers by using Alco facilities and experience on your processing problems. Contact your nearest Alco Products sales representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

ALCO

AMERICAN LOCOMOTIVE COMPANY

Sales and Service Offices in Principal Cities

Corrosion Inhibitor Checklist

This checklist may save you the time required for making a survey of the literature. It's an expanded version of the one in our September 1952 issue.

MAXEY BROOKE

A chemical engineer frequently finds himself processing a liquid in a vessel not designed to handle it. Economics dictate that he cannot change it and he can't stand the corrosion. Faced with this situation he has two alternatives: to live with it or to add an inhibitor.

Next comes the step of poring through handbooks and journals to find the appropriate inhibitor. This done, he can sit back and hope his choice is good.

All of this takes time. While our engineer is checking, his regular work is piling up on him. To get out of his strain, he frequently wishes that he had an inhibitor check list. So here it is. It makes no pretense of being complete but it does cover representative liquids and metals, as indicated in the references. Since the author has had no experience with most of the inhibitors listed, the list is not to be taken as an indication of the effectiveness of the individual inhibitors.

MAXET BROOKE is a chemical engineer with the Phillips Petroleum Co., Sweeny, Tex.

Metal	Environment	Inhibitor	Referenc
Admiralty	Ammonia, 5%	0.5% hydrofluoric acid	54
Admiralty	Sodium hydroxide, 4° Be	0.6 moles H ₂ S per mole NaOH	71
Aluminum	Acid hydrochloric, 1N	0.003 M α phenylacridine, β naphthoquinone,	
Augumtum	Acid nydroculorio, i.v	acridine, thiourea or 2-phenylquinoline	39
Alumainan	Acid mitric 9-507	0.05% hexamethylene tetramine	22
Aluminum	Acid mitric, 2-0/0	0.1% hexamethylene tetramine	22
Aluminum	Acid mitric, 10%	0.1% nexamethylene tetramine	22
Aluminum	Acid nitric, 10%	0.1% alkali chromate	16
Aluminum	Acid nitric, 2–5%	0.5 hexamethylene tetramine	
Aluminum	Acid phosphoric	Alkali chromates	52
Aluminum	Acid phosphoric, 20%	0.5% sodium chromate	16, 60
Aluminum	Acid phosphoric, 20-80%	1.0% sodium chromate	16, 60
Aluminum	Acid sulphuric, conc	5.0% sodium chromate	45
Aluminum	Alcohol anti-freeze	Sodium nitrite and sodium molybdate	6
Aluminum	Bromine water	Sodium silicate	10
Aluminum	Bromoform	Amines	44
Aluminum	Carbon tetrachloride	0.05% formamide	55
Aluminum	Chlorinated aromatics.	0.1-2.0% nitrochlorobenzene	21
Aluminum	Chlorine water	Sodium silicate	10
Aluminum	Calcium chloride, sat	Alkali silicates	59
	Ethanol, hot	Potassium dichromate	59
Aluminum	Ethanol, commercial	0.0207 ellecti combanates lestates	52
Aluminum	Ethanol, commercial	0.03% alkali carbonates, lactates, acetates or	***
	20.1 1 1 1	borates	50
Aluminum	Ethylene glycol	Sodium tungstate or sodium molybdate	41
Aluminum	Ethylene glycol	Alkali borates and phosphates	52
Aluminum	Ethylene glycol	0.01-1.0% sodium nitrate	7
Aluminum	Hydrogen peroxide, alkaline	Sodium silicate	75
Aluminum	Hydrogen peroxide	Alkali metal nitrates	20
Aluminum	Hydrogen peroxide	Sodium metasilicate	59
Aluminum	Methyl alcohol	Sodium chlorate plus sodium nitrite	42
Aluminum	Methyl chloride	Water	72
Aluminum	Polyoxyalkene glycol fluids	2% Emery's dimer acid (dilinoleic acid), 1.25%	12
Aluminum	1 DIJON Jainelle gij con maids	N(CHMe ₂) ₂ , 0.05-0.2% mercaptobenzothiazole	43
Aluminum	Sea water	0.75% sec. amyl stearate	40
	Sodium carbonate, dilute	Sodium fluosilicate	
Aluminum			
Aluminum	Sodium hydroxide, 1% Sodium hydroxide, 1%	Alkali silicates	59
Aluminum	Sodium hydroxide, 1%	3-4% potassium permanganate	17
Aluminum	Sodium hydroxide, 4%	18% glucose	57
Aluminum	Sodium hypochlorite contained		
	in bleaches	Sodium silicate	58
Aluminum	Sodium acetate	Alkali silicates	59
Aluminum	Sodium chloride, 3.5%	1% sodium chromate	22
Aluminum	Sodium chloride, 3.5% Sodium carbonate, 1%	0.2% sodium silicate	
Aluminum	Sodium carbonate, 10%	0.05% sodium silicate	28
Aluminum	Sodium sulfide	Sulfur	
Aluminum	Sodium sulfide	1% sodium metasilicate	59
Aluminum	50% sodium trichloracetate soln.	0.5% sodium dichromate	1
Aluminum	Tetrahydrofurfuryl alcohol	1% sodium nitrate or 0.3% sodium chromate	
		107 andium metacilianta	15
Aluminum	Triethanolamine	1% sodium metasilicate	22
Brass	Carbon tetrachloride, wet	0.001-0.1 aniline	53
Brass	Furfural	0.1% mercaptobenzothiazole	36
Brass	Polyoxyalkene glycol fluids	2.0% Emery's acid (dilinoleic acid), 1.25%	
		N(CHMe ₂) ₁ , 0.05-0.2% mercaptobenzothiazole	43
Brass	50% sodium trichloracetate soln.	0.5% sodium dichromate	1
		References on p. 234. Table continues or	

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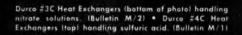
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TOLEPHONE WHITEIMALL JATES

Metal	Environment	Inhibitor	leferen
Cadmium plated steel.	55/45 ethylene glycol-water.	1% sodium fluorophosphate	12
Copper	Fatty acids as acetic	H ₂ SO ₄ , (COOH) ₂ or H ₂ SiF ₆	63
Copper	Hydrocarbons containing sulfur	P-hydroxybenzophenone	61
Copper	Polyoxyalkene glycol fluids	2% Emery's acid (dilinoleic acid), 1.25%	O.
PP	2 oryonyminome gry cor maios	N(CHMe ₂) ₃ , 0.05-0.2% mercaptobenzothiazole	43
Copper & brass	Acid sulfuric, dil	Benzyl thiocyanate	68
Copper & brass	Ethylene glycol	Alkali borates & phosphates	22
Copper & brass		O 4 1 607 No. DO mlss	22
copper & brass	Polyhydric alcohol anti-freeze	0.4-1.6% Na ₃ PO ₄ plus 0.3-0.6% sodium silicate plus 0.2-0.6% sodium mercaptobenzothiazole	
		0.3-0.6% sodium sincate plus	00
C & L	D1-9	0.2-0.6% sodium mercaptobenzothiazole	62
Copper & brass	Rapeseed oil	Succinic acid	9
Copper & brass	Sulfur in benzene solution	0.2% 9, 10 anthraquinone	29
Copper & brass	Tetrahydrofurfuryl alcohol	1% sodium nitrate or 0.3% sodium chromate	15
Copper & brass	Water-alcohol	1% sodium nitrate or 0.3% sodium chromate 0.25% benzoic acid, or 0.25% sodium benzoate	
		at a pH of 7.5-10	23
Galvanized iron	Distilled water	15 ppm. mixture calcium and zinc metaphos-	
		phate	77
Galvanized iron	55/45 ethylene glycol—water	0.025% trisodium phosphate	12
Iron	Nitroarylamines	Dibenzylaniline	19
Lead	Carbon tetrachloride, wet	0.001-0.1% aniline	53
Magnesium	Alcohol	Alkaline metal sulfides	16
Magnesium	Alcohol, methyl		
		1% oleic or stearic acid neutralized with ammonia	
Magnesium	Alcohols, polyhydric	Soluble fluorides at pH 8-10	26
Magnesium	Glycerine	Alkaline metal sulfides	16
Magnesium	Glycol	Alkaline metal sulfides	16
Magnesium	Trichlorethylene	0.05% formamide	55
Magnesium	Water	1% potassium dichromate	8
Monel	Carbon tetrachloride, wet	0.001-0.1% aniline	53
Monel	Sodium chloride, 0.1%	0.1% sodium nitrite	72
Monel		0.1% sodium nitrite	72
Nickel & silver	Tap water	0.1% Boulum mitrite	12
NICKEI & BIIVET	Sodium hypochlorite contained	0-1:	PC
14 - 1 - 4 - 1	in bleaches	Sodium silicate	58
tainless steel	Acid sulfuric, 2.5%	5–20 ppm. CaSO _{4.5} H ₂ O	35
Stainless steel	Cyanamide	50-500 ppm. ammonium phosphat	65
Stainless steel, 18-8	Potassium permanganate con-		
	tained in bleaches	Sodium silicate	58
Stainless steel, 18-8	Sodium chloride, 4%	0.8% sodium hydroxide	49
Steel	Acid citric	Cadmium salts.	37
Steel	Acid sulfuric, dil	Aromatic amines	51
Steel	Acid sulfurio 60 7007		
	Acid sulfuric, 60-70%	Arsenic	74
Steel	Acid sulfuric, 80%	2% boron trifluoride	4
Steel	Aluminum chloride—hydrocar-		
	bon complexes formed during		
	isomerization	0.2-2.0% iodine, hydriodic acid or hydrocarbon	
		iodide	30
Steel	Ammoniacal ammonium nitrate	0.2% thiourea	40
Steel	Ammonium nitrate-urea solns.	0.05-0.10% ammonia	18
	THE STATE OF THE S	0.1% ammonium thiocyanate	
Steel	Being containing overen	0.001-3.0 methyl, ethyl or propyl substituted	
redel	Brine containing oxygen		465
141	0 1 11 . 11	dithiocarbamates	48
steel	Carbon tetrachloride, wet	0.001-0.1% aniline	53
Iteel	Caustic—cresylate solution as in		
	regeneration of refinery caustic		
	wash solutions, 240-260 F	0.1-1.0% trisodium phosphate	3
steel	Ethyl alcohol, aqueous or pure.	0.03% ethylamine or diethylamine	25
Steel	55/45 ethylene glycol—water	0.025% trisodium phosphate	12
steel	Ethylene glycol	Alkali borates & phosphates	22
Steel	Ethylene glycol	Guanidine or guanidine carbonate	200
steel	Ethyl alcohol, 70%		
MCASI	Excity account, 10%	0.15% ammonium carbonate plus 1% am-	=0
1	** * *	monium hydroxide	56
teel	Furfural	0.1% mercaptobenzothiazole	36
Iteel	Halogenated dielectric fluids	0.05-4% (γC ₄ H ₃ S) ₄ Sn, γ(C ₄ H ₃) ₂ Sn or γC ₄ H ₃ S	
		SnPh ₄	24
iteel	Halogenated organic insulating		
	materials as chlorinated dipheryl	0.1% 2, 4(NH ₂) ₂ C ₆ H ₃ NHPh, o-MeH ₄ NH ₃ or	
		p-NO ₂ C ₄ H ₄ NH ₂	31
Iteel	Herbicides as 2, 4 dinitro-6-	p 1103041411121111111111111111111111111111	0.
	alkyl phenols in aromatic oils.	10.180/ funfamel	32
teel		1.0-1.5% furfural	
	Isopropanol, 30%	0.03% sodium nitrite plus 0.015% oleic acid	72
teel	1:4 methanol—water	To 41. water and 11. methanol add 1 g. pyridine	0.0
		and 0.05 g. pyragallol	66
teel	Nitrogen fertilizer solutions	0.1% ammonium thiocyanate	2
teel	Phosphoric acid, conc	0.01-0.5% dodecylamine or 2 amino bicyclohexyl	
		and 0.001% potassium iodide, potassium iodate	
		or iodacetic acid	47
	Polyovyalklane glycol flyida	90/ Emery's said (dilingleis said)	
tool	Polyoxyalklene glycol fluids	2% Emery's acid (dilinoleic acid)	43
teel		1.Zo% N(CHMes)s	
teel			
		0.05-0.2% mercaptobenzothiazole	
teelteel	Sodium chloride, 0.05%	1.25% N(CHMe ₂) ₁ 0.05-0.2% mercaptobenzothiazole 0.2% sodium nitrite	72
teelteel	Sodium chloride, 0.05%	U.2% sodium nitrite	72 1
teel		0.05-0.2% mercaptobenzothiazole 0.2% sodium nitrite 0.5% sodium dichromate Formaldehyde.	

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Metal	Environment	Inhibitor	Reference
Steel	Tetrahydrofurfuryl alcohol	1% sodium nitrate or 0.3% sodium chromate	15
Steel	Water	Benzoic acid	
Steel	Water for flooding operations	Rosin amine	
Steel	Water saturated hydrocarbons.	Sodium nitrite	73
Steel	Water, distilled	Aerosol (an ionic wetting agent)	
Tin	Carbon tetrachloride, wet	0.001-0.1% aniline	
Tin	Chlorinated aromatics	0.1-2.0% nitrochlorobenzene	21
Tinned copper	Sodium hypochlorite contained	70	
	bleaches	Sodium silicate	58
Tin plate	Alkali cleaning agents as tri-		
	sodium phosphate, sodium car-		
	bonate, etc	Diethylene diaminocobaltic nitrate	34
Tin plate	Alkaline soap	0.1% sodium nitrite	64
Tin plate		2% mesityl oxide, 0.001% diphenylamine	76
Tin plate		0.2% sodium nitrite	72
Titanium	Hydrochloric acid	Oxidizing agents as chromic acid or copper	
		sulfate	33
Titanium	Sulfuric acid		33
Zinc	Distilled water	15 ppm. mixture calcium and zinc metaphos-	
		phates	

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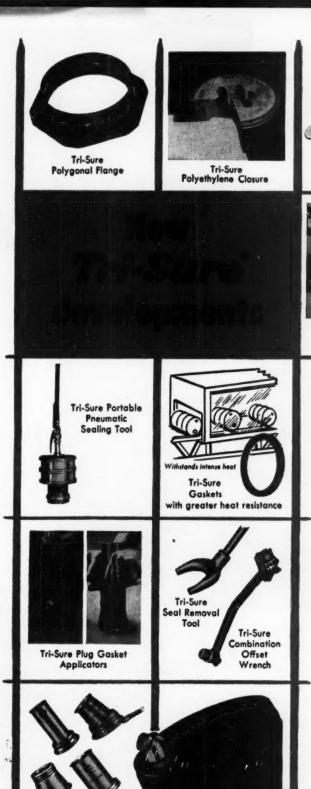
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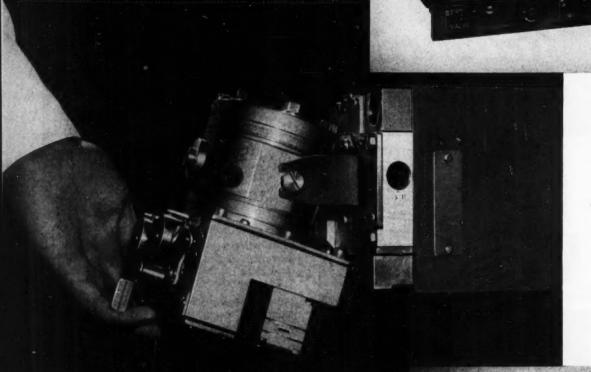
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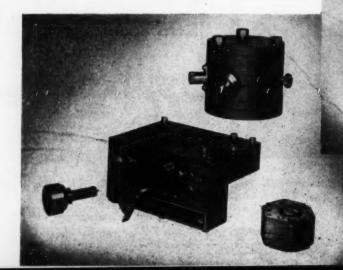
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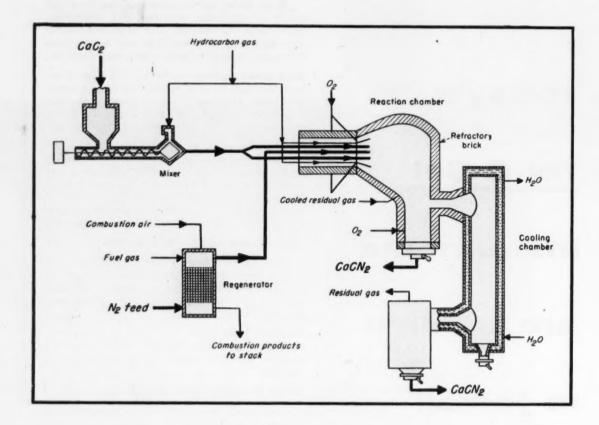
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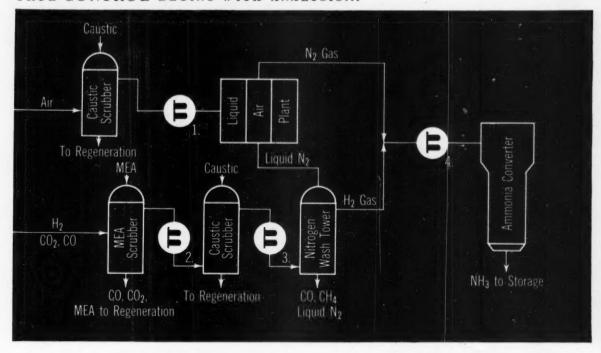
- ▶ Solid-Gas Suspension—First step in the process is the feeding of pulverized calcium carbide and hydrocarbon carrier gas (under pressure) into a mixer. The resulting solid-gas suspension, traveling at a speed fast enough to prevent solid separation, flows to a refractory brick reaction chamber.
- ▶ Nitrogen Absorption Here the gaseous suspension comes in contact with (1) preheated nitrogen—coming from a regenerator and (2) excess hydrocarbon gas and oxygen

-to maintain the desired combustion temperature.

The reactor's nozzle arrangement (see above) forms a high-temperature zone in the middle of the chamber. In this zone suspended calcium carbide heats up to such a degree that the exothermic reaction between it and preheated nitrogen produces a high yield of cyanamide.

Cooled gas, entering near the reactor ov.tlet, suddenly lowers the temperature of the reaction media causing part of the product to sepa-

To get any patents, including those mentioned here, order from the Commissioner of Patents, Washington 25, D. C. Each patent costs 25 cents. TRUE CONTROL BEGINS WITH ANALYSIS...



TRI-NONS Up Ammonia Plant Efficiency 10%

Would you like to increase ammonia throughput by 10 percent—without plant expansion?

With a Perkin-Elmer TRI-NON Analyzer you can get a continuous measure of the CO₂ level with an accuracy of ½-½ ppm in the range 0-25 ppm (analyzer #1 in the above flow diagram). The Analyzer determines optimum balance between caustic use and CO₂ removal efficiency. If NH₃ throughput is 250 tons a day and caustic utilization is raised from 70-80 percent or more, this factor alone means a savings of \$4,500-\$6,000 per year.

The same analyzer can be used for the synthesis gas stream and can also measure the CO₂ level of the input to the MEA and caustic scrubbers (analyzers #2, #3). At

this level, the equipment is paid off in less than a year of operation *plus* the added insurance against trouble if throughput is raised over design capacity.

The same holds true for the ppm CO level of the final mixture sent to the catalyst (analyzer #4). CO is a catalyst poison even at low levels. But how poisonous at what level is not well known. With proper control of the CO level, you can save \$8,000-\$10,000 by extending catalyst life. Again an Analyzer pays for itself plus the added insurance of increasing throughput with confidence that all is under control.

Let Perkin-Elmer engineers show you how your process can benefit through ANALYTICAL CONTROL—made possible with infrared plant stream analyzers.

*TM Perkin-Elmer Corp.



Both the TRI-NON and BICHROMATOR Analyzer continuously record the concentration of any desired stream component. Each is sensitized and adjusted to specific plant conditions before shipping.

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Gentlem	en:	
	information on the application of the following process problem:	
☐ Send	literature on your infrared plan	t stream analyzers
☐ Hove	a sales engineer call	
Name		Title
Company	·	
Address		

PERKIN ELMER - FIRST IN ANALYTICAL CONTROL

rate at the bottom. Oxygen addition—at the reactor outlet—removes any deposited elemental carbon.

▶ Final Separation—From the reactor, remaining products go to a water-jacketed cooler, thence to a set of cyclone separators for final separation.

Cooled residual gas recirculates

-as cooling gas—to the reactor.—

U. S. 2,687,945 by Joseph Daniels.

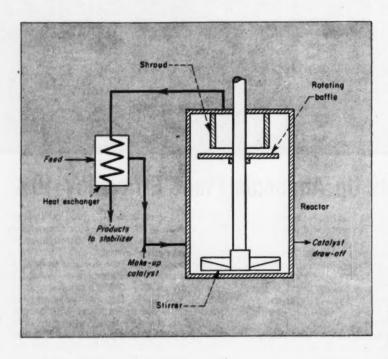
Crystallizer Design Approaches Ideal

Continuous process, high cooling rates, large crystal formation. Here's how these three requisites for near-ideal crystallization have been incorporated into a new crystallizer design.

► Wall. Cooling — Hot concentrated solution passes continuously

through a bath which is cooled only at the wall. The latter is kept free of crystals at all times.

Heat is eliminated so rapidly that more nuclei form per unit time than crystals discharge. Excess nuclei are removed by contacting them with hotter portions of liquid. —U. S. 2,684,891 by Theodorus J. J. Hoek to De Directie van de Staatsmijnen in Limburg.



Novel Approach to Polymerizing Olefins

Making motor fuel liquid hydrocarbons from polymerized gaseous olefins need no longer be a problem. So claims Standard Oil Development Co. in its recently granted patent for a polymerization reactor. Fluidized vs. Fixed Bed—And this is how the process is made easy. Unlike conventional reactors using a moderately active catalyst in a fixed-bed operation, the new reactor utilizes a fluidized solid or slurry-type operation—with a suspension of finely divided catalyst in fluid reactants (at pressures above the critical).

Good mixing, a feature of such

a fluid operation, insures uniform composition and temperature throughout the reaction zone. Thus early catalyst deactivation—due to local overheating, as in fixed-bed operation—is eliminated.

But accompanying this mixing is a loss of catalyst in the effluent. Therefore the reactor has been designed to avoid such carry-over.

Polymerization—But now for the process. A normally gaseous C_a·C_a hydrocarbon fraction (50% paraffins, 25% propylene, 25% butylene)—at 100 F. and 125 psig.—is heated to 250 F. in a heat exchanger.

Heated feed then enters the bottom of a reactor (at 450 F. and 1,000 psig.) containing finely divided catalyst—phosphoric acid deposited on kieselguhr of about 140–200 mesh.

Agitation maintains a suspension of catalyst in feed, with the latter traveling through the former at about 1-2 feet per minute. Denser catalyst particles lag behind the less dense liquid. And catalyst concentrates—in a dense-phase mass—at the reactor bottom.

Preferred temperatures and pressures approximate those critical for a 50:50 mixture of polymer: C_r-C_s, but are outside the range in which two fluid phases appear. Reaction zone pressures of about 1,000 psig. are satisfactory to maintain the desired single-phase system.

► Catalyst Preparation—To prevent catalyst agglomeration, 10-50 wt. % of finely divided (140-200 mesh) silica gel is mixed with the phosphoric acid-kieselguhr. And, if necessary, water is regularly added to insure adequate catalyst hydration.

Products exit through a shroud (enlarged outlet) at the top of the reactor and pass through the heat exchanger where they give up heat to incoming feed. Cooled products go to a stabilizing column.

From time to time catalyst is removed from the reactor and burned.

▶ No Catalyst Carryover — When the reactor operates under optimum mixing conditions, a sizable amount of catalyst is entrained in the effluent vapors. To get around this, the agitator shaft has a rotating baffle—just below the shroud. The latter's cross-sectional area is such that effluent rate of flow

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Minimum downtime required for replacement of parts

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Economical pump for every requirement

Individual engineering on every application. Write, wire or phone for complete details, Wilfley's remarkable success-record in creating substantial dollar savings in power and maintenance means low-cost production on every pumping job. This cost-saving efficiency is born of engineering "know-how" plus many years of experience in keeping pace with the changing requirements of modern industry.

Shown here are typical Wilfley installations. Rubber lining, alloy irons, plastics and stainless steel are some of the materials used in Wilfley Sand Pumps and Acid Pumps to provide maximum pumping efficiency.



through it is less than the catalyst's settling rate.

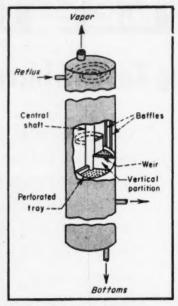
The baffle prevents catalyst from being carried into the shroud; rotation prevents it from settling on the baffle.—U. S. 2,686,110 by John A. Carver to Standard Oil Development Co.

New Scavenger Effects Xylenes Separation

Perfluorobutyric acid joins the ever-growing list of scavengers for separating xylenes from non-aromatics by azeotropic distillation. Its job: to separate ethyl benzene from *m*- and *p*-xylenes.

Relative volatilities up to 1.22 have been obtained in the presence of the acid as compared with 1.06 in its absence.

The inventor also claims that similar fluorinated compounds can be used in the extractive distillation separation of benzene from cyclohexane.—U. S. 2,684,935 by Otto Redlich and Charles M. Gable to Shell Development Co.



Novel Tray ArrangementFor Distillation Tower

For something new in distillation columns, take a look at this—a tower characterized by a low pressure drop. As shown, a shaft (sealed both at top and bottom) runs up the center of the column, supporting a series of trays. These trays—highlights of the new design—have several distinguishing features:

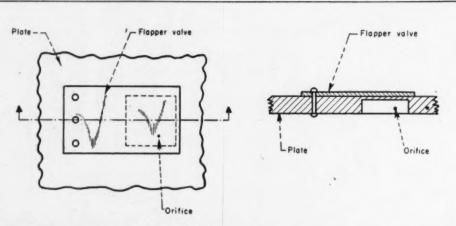
 They're arranged in spiralstairway fashion.

They're perforated to provide a liquid spray below each one of the trays.

• They have weirs—on the downstream side—to help maintain the desired liquid head on each tray. Vertical partitions, extending down from the weirs, seal off the openings between trays.

► Vapor's Course—Vapor rises spirally, passing through a spray above each tray. Two conditions—horizontal (rather than vertical) vapor flow and a centrifuging effect—help to disengage liquid from vapor. Result: there's less entertainment than usual.

Vertical baffles around the tower wall disengage and drain liquid from the wall.—U. S. 2,684,936 by George L. Lupfer to Standard Oil Co. (Ohio).



New Fluid Contacter Features Flexible Flappers

Flexible flapping valves—in a new fluid contacter—are the key to dispersing a fluid (liquid or vapor) into a liquid. Here's how they work.

The valves are nothing more than thin metal plates, each plate covering a single orifice or aperture. As fluid is supplied under pressure, each valve lifts slightly, allowing a thin stream of fluid to pass through it. This stream then disintegrates into small globules in the liquid above the plate.

If a large number of orifices clog up, the resulting back pressure lifts the valves higher—permitting passage of solids through them. Thus the apparatus tends to be self-cleaning. Overlap of flapper valve and plate prevents reverse flow of liquid from above. This set-up may be used in any liquid-gas or liquid-

This set-up may be used in any liquid-gas or liquidliquid contacting process including distillation, gas absorption, liquid aeration, etc.—U. S. 2,687,287 by Philip D. Coppock to Distillers Co. Ltd.

Which of these 22 tube steels will give you maximum tube life per dollar? Ask the experts!

This month's report is on:

2% CR.-MO.

Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200° F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return-bend forgings for oil heaters.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

Carlan	6:	6:	
Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 21/2	Sicromo 5MS	16-13-3
DM-2	24% Cr1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% CrMo.	18-8 Stainless	35-15**
2% CrMo.	4-6% CrMoTi.	18-8 Cb	16-25-6**

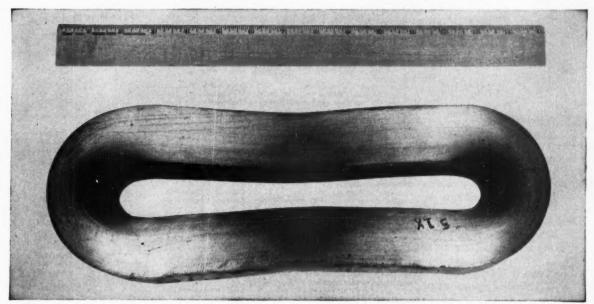
* Available as seamless tubing on an experimental basis only.

**Not available as seamless tubing.

FOR every high temperature application, there's one tube steel that gives you the best life-cost ratio. One steel best answers your particular set of temperaturepressure-corrosion-oxidation conditions. That's why the Timken Company makes the 24 different high temperature steels shown in the box at left.

To find the one best steel for each of your applications, ask the Timken Company metallurgists. They're experts. They know how to balance the various factors against cost-and recommend the analysis that gives you maximum tube life per dollar of cost. They've been doing it for 20 years. And remember-regardless of analysis, you get uniform quality in every Timken® tube because we rigidly control quality at every step from melt shop through final inspection.

Put our "RSQ"-Research, Supply, Quality-to work on your tube problems. Ask the experts! The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".



Flattened test of 101/2" O.D. by 1.580" wall of 18-8 Cb showing the excellent ductility of large, heavy-wall Timken seamless tubing.



SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

Your Checklist of New Equipment Patents

Operation	About	Inventor or Assignee	Patent No
Adeorption	Vapor separation in fluidised adsorption	Universal Oil Products Co	2,687,783
Crushing and grinding	Gyratory crusher	Smith Engineering Works	
	Stone crusher	Nelson H. Bogie	
Distillation	Bell cap arrangement	Standard Oil Development Co	2,686,046
Extrusion and molding	Forming molded plastic	Aircraft-Marine Products, Inc	
	Extrusion press for forming plastic strip	Frank R. Gross	2.686.335
	Molding thermoplastics	Imperial Chemical Industries Ltd	2,686,933
	Injection molder	Michael D'Amore	2,686,934
	Molding nylon	The Polymer Corp. (Pa.)	2.686,935
Fluid and particle flow	Conveying fine solids	William W. Odell	. 2,686,085
	Fluidized-bed floating baffle	Phillips Petroleum Co	. 2,687,343
	Pneumatic conveyor for pulverised solids	Fredrick J. Cherewick	2,687,920
Heat transfer	Curved-tube heat exchanger	Soc. Anonyme John Cockerill.	2,686,044
	How to manufacture heat exchanger sections	A. O. Smith Corp	
	Fluid heater	Foeter Wheeler Corp	. 2.687,119
and the same of th	Flue conduit with internal heat transfer elements	Bock Corp	2.687,747
Mixing	Roll-bar grinding mill for solid-liquid dispersions	Vickers-Armstrongs Ltd	2.687,852
Solid-gas separation	Cyclone separator	Monsanto Chemical Co	2.686,573
	Variable capacity dust remover-scrubber	The Fish Engineering Corp	2,687,184
	Wet scrubber type gas cleaner,	Frank R. Culhane	. 2,687,780
Solid-liquid separation	Centrifugal separator	Baker Perkins Inc	2,686,595
Solid-solid separation	Minerals separator	Hugo S. Miller	
	Froth flotation apparatus	Pearson M. Payne	
	Froth flotation apparatus	Norman A. MacLeod.	2.687.213

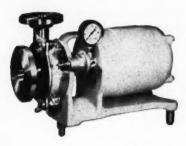
... And New Process Patents

Product	Process	Inventor or Assignee	Patent No.
Carbon	Making nonscorehing carbon black	Godfrey L. Cabot. Inc	2.686.107
Catalysta	Regenerating ailver catalyst for ethylene oxide preparation		
		Union Oil Co. of Calif	2,687,381
Detergents .	Preparing nonfoaming surface-active alkyl ben- zene sulfonate	Monsanto Chemical Co	2,683,692
	Neutralization of sulfonated cpds. for use as detergents	Colgate-Palmolive Co	2,687,420
Fuels	Gasification of carbonaceous solids	Hydrocarbon Research, Inc	2,683,657
	Tapping liquid slag from pressure gas producers.		
	Hydrogen-rich gas from gasified carbonaceous solids	Hydrocarbon Research, Inc	
Hydrocarbons	Removing vanadium and sodium from petroleum hydrocarbons		
Inorganic chemicals	Solution mining of potassium cpds	Kansas City Testing Laboratory	
			2,685,505
	Blanc fixe preparation		
	Generating sodium monoxide		
	Boron preparation		2,685,501
Metals and ores	thetic manganese oree	Dept. of the Interior	
	Ammoniacal leaching of copper		2,687,953
Organic chemicals	Alkylated phenols separated by solvent extrac- tion	American Cyanamid Co	2,684,388
	Phenole alkylation	Gulf Research & Development Co	2,684,389
	Electrothermic production of CS2		2,684,393
	Drying methyl ethyl ketone	Stanolind Oil & Gas Co	2.684,934
	Protein isolated from protein-containing cpds		2.684,960
	Sugar chlorination	Sharples Chemicals, Inc	2.684,961
	Olefin oxides manufacture	Union Oil Co. of Calif	2,684,967
	Preparing organic metal esters		
	Naphthalene disulfonic acid as a catalyst in isopropenyl acetate manufacture	Imperial Chemical Industries Ltd	2,684,980
	Production of cyclic alcohols and ketones	Shell Development Co	2,684,984
	Separating methyl propyl ketone from valer- aldehyde-containing mixtures		
Pigmenta	Preparing composite CaSO-ZnS pigments	Orr's Zinc White Ltd	2.687.972-4
Plastics	Manufacture of halogenated polymers	The M. W. Kellogg Co	
Resins			
	Resins from diallylidene pentaerythritol and a polyhydroxy alcohol	Dynamit-Actien-Gesellschaft vormals Alfred Nobel & Co.	2,687,407.
	Liquefaction and stabilization of pine resin	Vitex S. A. Anciens Establissements J. Canouet .	2,687,409
Rubber	Continuous vulcanization of covered electrical	Justin H. Ramsey	2,683,285
	Synthetic zubber copolymer of butadiene and acrylonitrile	Standard Oil Development Co	2,684,356
	Rubber vulcanisation	Dunlop Rubber Co. Ltd	2,684,391
Synthesis gas and products	Hydrocarbon synthesis with reduced magnetite catalyst	The M. W. Kellogg Co	
	Hydrocarbon synthesis	Standard Oil Development Co.	2.686.195-6
	Oxo process	Standard Oil Co. (Ind.)	
	Producing hydrocarbons and oxygenated epds	The M. W. Kellogg Co	
Synthetic fibers	Artificial protein threads treated with cyanic		
9.	Precipitating synthetic polyamides in combina- tion with silk fiber	Edward E. Verdiers	2,685,570
	Manufacture of crimped, stabilised acrylonitrile fibers	The Chemstrand Corp	2,686,339
	Synthetic fiber preparation	Monaanto Chemical Co	2.687.393

Add longer life and greater economy

to your processing lines.





For top quality Centrifugal Pumps... be sure to investigate the many advantages offered through the use of Tri-Clover corrosion-resistant industrial pumps for an extremely wide range of applications. For complete details, write for new Catalog 253. • Tri-Clover Butt Welding Fittings in Stainless Steel
Type 304, 347, 316 and other analyses, are custom fabricated
from highest quality materials by skilled craftsmen backed
by years of specialized experience. Because of this
quality, plus full corrosion resistance and longer life, the end
result is greater economy in process line service.

Tri-Clover Zephyrweld® lightweight welding fittings are made in tube O.D. sizes from ½" through 24" and 36". Those through 4" are annealed, pickled and passivated. Larger sizes are annealed, and are passivated on request. Available in all standard fitting types.

Available in all standard fitting types.

Tri-Clover Schedule 5 and 10 welding fittings are made in a full line, for use with light gauge pipe in sizes from ½" through 24" and 36".

Schedule 40 welding fittings are available in sizes from ½" through 12". Information on request.

For stainless steel welding fittings for every process need, be sure to specify TRI-CLOVER.

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SOLID WEDGE

A variety of potterns for 125-150-200-300 and 350 lb. service, including Underwriters' Approved valves, also Solder End, Socket End, and Quickopening Gates.

SPLIT WEDGE

Union bonnet, traveling spindie patterns for 125 and 150 lb. service. Also the popular SWINGTITE fast-action Lever Gate.

MONEL SEATING

For long-range economy in destructive services, the Jenkins line includes the 200 and 300 lb. valves illustrated (right). Available with MONEL rings and bronze wedge, or MONEL rings and nickel alloy wedge for exceptionally severe conditions.





JENKINS BRONZE GATES WITH MONEL SEAT RINGS

BRONZE WEDGE

200 lb. 300 lb. Fig. 270-U Fig. 270-UI. (U.L. approved for L.P.G. service)

NICKEL ALLOY WEDGE 200 lb. 300 lb. Fig. 270-UN Fig. 280-UN Look over the list of 40 patterns in Jenkins complete line of Bronze Gates. You'll find the valve you need, and you can be sure it is built to provide the *extra value* that makes Jenkins the best buy for any service.

This new folder includes a handy chart for quick reference, and describes many features of the most popular patterns that assure easy maintenance and long wear. It's convincing evidence that the Jenkins line includes "a valve for every service" — valves that take top-rating in any test for endurance and economy.

You will want this up-to-date information on Jenkins Bronze Gates. Use the folder to plan your hookups for lasting economy.

GET THIS NEW BRONZE GATE FOLDER from your Jenkins Valve Distributor or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Form 181-C.

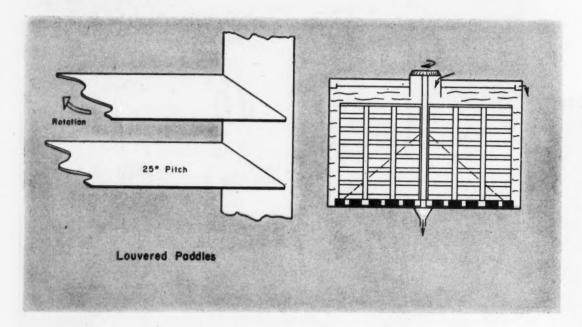


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Process Equipment News Edited by Calvin S. Cronan

NEW PROCESSING EQUIPMENT



Speed Gravity Settling in Big Decanters

They can pep up throughput rate of installed thickeners or—cut the size of those still to be built. Either way there's hope of getting more for your dollar.

Not the least of news from France these days, for chemical engineers, is word of a new slant on decantation—the Gelsol process. Running side by side with an equivalent conventional thickener, washing Bauxite mud, it has doubled the throughput rate and delivered a thicker mud. And it's said to be showing equally interesting results in a potash refinery, collieries and ore treating plants.

▶ Where Solids Gather—Wherever insoluble settleable solids are found suspended in liquid it is possible to apply the Gelsol process. It is equally effective on individual particles or flocculated fine solids; does not interfere with their settling. Rather it accelerates settling rate and compacts the sludge.

▶ The Magic Touch—It's only a touch but apparently that is all that is needed to speed solids on their downward path. Solid blades, preferably curved, or grills forming a sharp angle with the horizontal plane move slowly through the body of liquid.

It is said that an inclined blade of this type produces a vertical force component that, added to the force of gravity, improves settling. Also deflection of the slurry contributes to the improvement.

In the compression zone the blades appear to liberate trapped water producing a more concentrated sludge.

► How Installed—For slurries that produce mobile sludges the Gelsol blades are installed with suitable

spacing as illustrated above. They are an integral part of the scraping

Speed of the scraping arm is regulated to avoid agitation of the liquid. At the circumference it should never exceed 20 cm. per sec. (7.9 in. per sec.).

One modification of the Gelsol device is installed in vessels where the thickened mud tends to solidify or cake. In case of clogging the blades remove easily for cleaning.

In rectangular tanks the blades are moved along the length of the vessel. At the end of each stroke a simple device reorients the blades to form a sharp angle in the direction of movement.

The Gelsol device is particularly suited for installation in existing cylindrical decanters which do not have an upper level. However they have been used successfully in a two-compartment, 75 ft. dia. decanter handling a non-clogging slurry.

Only the Wiggins Gasholder*







has the dry fabric seal that







eliminates maintenance problems!







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135 South La Salle Street
Chicago 90, Illinois

Equipment on these pages made news this month . . .

Equipment Cost Index, p. 252	Page number is also Reader Service code number
New Processing Equipment High-Capacity Thickener 248A Gas Circulator 250A Ultrasonic Generator 252B Revamped Cyclone 252A Water Softener 252B Pellet Cutter 252C Protected Storage 252D	Transmitter 258C Electronic Tank Gage 258D Dew Point Hygrometer 260A Oxygen Analyzer 260B Transducer 260C Thermistor Controller 260D Explosion-Proof Level Indicator 260E Pressure Transmitter 260F
New Maintenance Tools & Supplies Protective Suit .254A Sheet Packing .254B Cleaning Machine .254C Pipe-Fitting Tool .254D New Heating & Cooling Equipment .256A Hot Oil Heater .256B Electric Heater .256B Heating Panels .256C	New Fluids Handling Equipment Two-Stage Pump 262A Plastic Pipe 262B Graphite Pump 262C Stainless-Steel Valves 262D Proportioning Pump 262E
Electric Heaters	New Materials of Construction 264A Ceramic Veneer 264B Stainless Steel 264B
New Instruments & Controls Magnetic Flow Meter	Mastic Coating

▶ Comparative Results — Gelsol blades have been installed in an aluminum plant in a vessel handling the first stage washing of bauxite muds. Performance was charted for 75 days compared to two other decanters of conventional design working on the same operation.

Feed rate to all three units was 75 gpm. of mud containing 100 gpl. of 60% insoluble Fe₀O₀, 37 gpl. of Al₀O₀ and 66.6 gpl. of caustic (as Na₀O). Temperature at the inlets was 90 C.

The Gelsol unit is designated A. Feed to it and B was identical and flocculated in the same manner. Feed to C had been flocculated in a previous stage.

The average concentration of insolubles in the thickened muds over the 75 day period was:

Vessel A 405 gpl.
Vessel B 324 gpl.
Vessel C 284 gpl.

A test on a higher 150-gpm. throughput for vessel A compared to vessel C at 75-gpm. throughput showed the effluent to remain clear while the mud was 10% more concentrated than that of vessel C.

The Gelsol process has been patented in France and various other countries. Applications are also pending in the U.S. and elsewhere.—Chemical Projects Associates, 30 Rockefeller Plaza, New York 20, N. Y. 248A

Gas Circulator

For ammonia synthesis is multi-stage, rotary type.

In this country, circulation of mixed nitrogen and oxygen in high-pressure ammonia synthesis has been handled until recently by reciprocating compressors. But when Spencer Chemical' Co. laid out its new ammonia facility at Vicksburg, Miss. it installed a German-built rotary unit that cuts oil contamination and lengthens catalyst life.

Having a multi-stage rotary design, the Maulwurf pump is built with both the pump and the drive motor enclosed within a pressureproof housing at full system pressure. With a gas-stream pressure in the range of 2,850 to 4,250 psi. the Maulwurf unit boosts the pressure 210 to 355 psi.

Standard models come in ratings from 118 to 235 cu. ft. per min. While there are normally 14 stages, from one to four can be omitted if maximum pressure rise is not required. Pressure-volume relationships curve only slightly so that the pump can operate far below or above the optimum point.—The Foram Corp., 76 Beaver St., New York 5, N. Y. 250A

Ultrasonic Generator

For wide range production of ultrasonic energy in plant or laboratory.

A wide-range, 400-w. ultrasonicenergy generator together with a variety of transducers fits both production line and laboratory needs. It is used for degreasing, emulsifying, impregnating, degassing, dispersing, coagulating, extracting, fragmenting and depolymerizing.



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a tough, corrosion-resistant plastic with a good cost factor

Dur-Ace is a new corrosion-resistant, rigid plastic pipe with exceptional impact strength and toughness . . . good for handling most corrosive fluids in your plant at moderate temperatures and pressures . . . with low first cost and long life.

Light in weight, Dur-Ace is odorless, tasteless, and non-contaminating. It maintains good strength, rigidity and chemical resistance from minus 40 deg. F. to 170 deg. F. As shown below, it handles all types of chemicals except a few strong acids and organic solvents. Dur-Ace is corrosion-resistant on the *outside* too, and saves the cost of painting. Electrolytic corrosion and bacteria have no effect on Dur-Ace, so it's excellent for underground lines handling water, brine, petroleum, natural gas, etc.

Successful field installations of thousands of Dur-Ace molded fittings have been made. We have job-proved performance data covering a wide variety of corrosives. Dur-Ace is available in pipe sizes from ½" to 2", Standard and Extra Heavy, with a wide variety of fittings.

Dur-Ace is the eighth basic type of corrosion-resistant pipe available from ACE... including materials for high pressures, high temperatures, strong acids, organic solvents, etc., and pipe sizes to 24" and above. Consult ACE first with any corrosion problem.

CHEMICAL RESISTANCE AT 77 DEG. F.

SATISFACTORY

Acetic Acid 10% Hydrechleric Acid 30% Sulphuric Acid 50% Ammenium Hydroxide 28% Calcium Hydroxide Sedium Hydroxide 20%

Ferric Sulphate Salts of Calcium, Sodium, Potassium,

Ammonium, etc. Bleaches Most Plating Sels. Oil (SAE 10-30)

LIMITED Formic Acid 20%

Hydroflueric Acid 10%
Nitric Acid 10%
Phospheric Acid 50%
Alcohols
Vegetable Oils

UNSUITABLE

listed at left Arematic Hydrocarbon Chlorinated Solvents Esters Ketones

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AMERICAN HARD RUBBER COMPANY 93 WORTH STREET - NEW YORK 13, N. Y.



Generator is tunable continuously over the frequency range from 10 to 1,200 kc./sec.

New types of transducers include metal jacketed and lined fully-enclosed, water-cooled treatment chambers where process materials are in contact only with metal surfaces. Another new type is a flanged flow-through chamber that can be bolted into a pipe line for continuous processing of materials.—Rich-Roth Laboratories, 1240 Main St., Hartford, Conn. 250B



Revamped Cyclone

Now built with removable rubber lining to slash maintenance cost.

Aiming for longer life and reduced maintenance costs, the Dorr Co. has redesigned Standard 6, 12 and 24 in. Dorrclones. Replaceable molded rubber inserts are expected to increase considerably the operating life of sections not previously lined. Sections will be easy to install and less costly than equivalent parts in the old design.

Greatest modification has been made in the 6-in. Dorrclone. The previous rubber-lined conical casting has been replaced by a twopiece cylindrical casting containing five, fitted, molded rubber sections. The conical classification chamber thus is formed by the interior shape of the two rubber cone-section liners.

Additional molded sections include a feed chamber liner, a vortex finder with a choice of six diameters and an apex section with a similar choice of openings.—The Dorr Co., Barry Place, Stamford, Conn. 252A

Water Softener

Designed to meet individual requirements.

A new line of zeolite industrial water softeners offers individual design to meet particular size and capacity needs. There is a choice of controls for either manual or automatic operation.

Standard equipment has multiport, single control valve. However, if desired a nest of individual valves can be furnished.

In automatic operation, the steps of backwashing, brining, rinsing and return to service are carried out automatically without operator attention. In semi-automatic operation, initiation of the regeneration cycle is controlled by push button.—Industrial Filter & Pump Mfg. Co., 5900 Ogden Ave., Chicago 50, Ill. 252B

Pellet Cutter

Reduces extruded plastic to pellets.

Uniform, dust-free plastic pellets are produced by the 700 line of cutting machines. Rod coming from the extruder is cut cleanly without forming feathers.

Thirty cutting knives are

mounted around the periphery of a roll that revolves up to 2,000 rpm. The cutting edge of each knife is almost perpendicular to the stock vertically as it meets the bed knife. Horizontally, the fly knife is at a slight angle so that the cut progresses across the face of the bed knife.

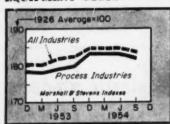
If desired, the machine can be equipped with supplementary pulling, stretching and feed rolls.—Taylor-Stiles & Co., 21 Bridge St., Riegelsville, N. J. 252C



Protected Storage

Beneath the hemisphere at Kaiser Gypsum's new Seattle plaster mill and board plant is storage space for 25,000 tons of minus 4 in. raw gypsum. Material unloaded from ships is delivered by conveyor through the top opening directly onto the single-conical storage pile. Full cantilever construction of the sheet-metal-covered hemisphere gives a clear span of 175 ft. and a pile height of 7 stories. Gains: economy of cost, maintenance and storage space.—Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif. 252D

EQUIPMENT COSTS



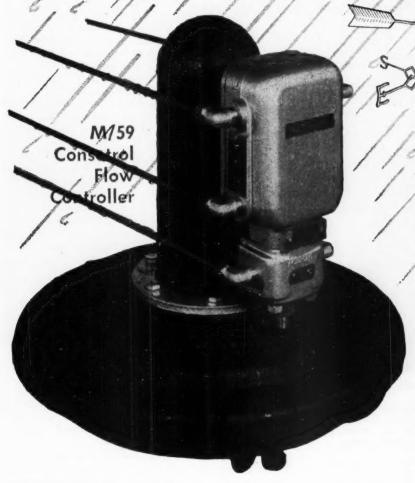
	June	Sept.
Process Industries	1954	1954
Cement mfg	178.0	177.3
Chemical	186.6	185.9
Clay products	172.8	172.1
Glass mfg	176.4	175.7
Paint mfg	179.7	179.0
Paper mfg	180.0	179.3
Petroleum ind	183.2	182.5
Rubber ind	185.6	184.9
Process ind ava	183.7	183.0

Related Industries

Elec. power equ	ip			188.5	187.7
Mining, milling	1			187.6	186.8
Refrigerating .			×	205.3	204.5
Steam power .				175.9	175.2

Compiled quarterly by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. See Chem. Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1954, pp. 214-5 for annual averages since 1913.

requires no more attention than a weathervane!



"Live-Balance" Control on any fluid with any size valve motor.

Lowest first cost. Lowest installed cost.

Lowest maintenance cost.

Unique Simplicity — exclusive design permits fixed, optimum proportioning and reset values for liquid flows. Adjustable reset optional for gas or steam flow. Like a weathervane, the Foxboro M/59 Consotrol Controller can be installed completely exposed to the elements . . . and forgotten about! Unsurpassed in performance by any other flow controller, the M/59 is completely indifferent to weather conditions.

This rugged Flow Controller mounts directly on the air connection of the valve... at a fraction of usual installation cost. Its case is tightly gasketed, continuously purged, completely weatherproof, highly resistant to dust, fumes, and vibration. There's nothing to align, nothing to wear out. A flexure-strip fulcrum eliminates the friction and wear of conventional pivots...eliminates "conventional" maintenance.

In operation, the M/59 fully utilizes the speed and sensitivity of the Foxboro d/p Cell Flow Transmitter... does away with transmission lag...gives fastest recovery from process upsets. For the complete story, write today for Bulletin 470.

THE FOXBORO COMPANY, 3612 NEPONSET AVENUE, FOXBORO, MASS., U.S.A.

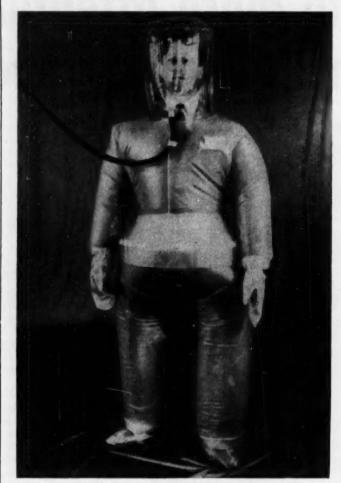
FOXBORO

FLUID FLOW CONTROLLERS

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

CHEMICAL ENGINEERING—December 1954

253



Tailored to Fit Atomic Age Protective Needs

Secure within his air-inflated plastic suit this engineer can avoid contact with radioactive dust and particles. It's a protective measure now in use in Britain's atomic energy research centers and plants producing materials for nuclear energy.

Sheet Packing

Gives tight seal up to 400 F against acids.

Acid-resisting compressed asbestos sheet packing R/M No. 1307 recently was placed on the market. It can be used against sulfuric, nitric and other acids in various concentrations where a tight seal is needed up to 400 F.

Packing is made of selected

white asbestos fibers completely impregnated and coated with an acid-resisting compound. It is claimed that gaskets cut from R/M No. 1307 packing will not be as fragile or brittle as those made from sheets using blue asbestos fibers. The new packing has higher tensile strength and better flexibility than others of its type.—Raybestos-Manhattan, Inc., Packing Div., Manheim, Pa. 254B

Cleaning Machine

Mounted on two-wheel trailer tackles tough plant cleaning.

Large volumes of hot water under pressure are delivered by the Hydro/Steam cleaner, model 4989-G. It's particularly suited for cleaning and odor removal in food and chemical processing plants.

Heart of the unit is a 40 hp. steam generator that can develop 120 psi. steam pressure two minutes after startup with cold water. It enables the unit to deliver 1,200 gph. of water at 180 F and 240 psi. The machine also can deliver hot water mixed with detergent or steam either with or without detergent.

Automatic controls on the steam generator cause the machine to make steam only when the cleaning gun is turned on. However, the steam generator automatically cycycles on and off to hold the working steam pressure.—Vapor Heating Corp., 6420 West Howard St., Chicago 31, Ill. 254C

Pipe Fitting Tool

Designed for fitting Haveg pipe on the job.

New hand-operated tool enables you to have your Haveg pipe fitting done on the job without need for using a machine shop lathe. It is felt that costly shutdowns or losses of materials in process can be avoided by making quick repairs with Haveg pipe.

New lines can be installed rapidly using stock lengths of prefabricated pipe. No longer is it necessary to draw up the complete bill of materials for advance fabrication

of lines.

Pipe to be faced and grooved is clamped in a standard plumber's chain vice. Then the tool, fitted with the proper tungsten-carbide-tipped cutter for the pipe size selected, is inserted into the pipe. By swinging the handle the pipe is faced for a tight gasket fit and grooved for perfect flange seating without forcing.—Haveg Corp., Newark, Del. 254D

B. F. Goodrich Chemical saw materials



All rigid vinyl feeder handles sulfuric acid 24 hrs. a day

THE feeder shown here surprised sulfuric THE feeder shown here supplies a acid to a production process. It is in use 24 hours a day, 7 days a week, yet has required no maintenance or repairs after more than 6 months of this severe service.

This marvelous record of trouble-free operation is due to the outstanding corrosion resistance of Geon rigid vinvl from which all parts of the feeder, except the motor, are made. Similar feeders made from other materials frequently broke down in service causing production delays and creating hazards to operating personnel.

This success story of Geon rigid vinyl is one of many in which this unique material is setting new records in industry for handling corrosive materials. Furthermore, Geon rigid vinyl is tough, strong and has excellent electrical properties.

This all rigid vinyl feeder may give you an idea for an equally successful application. There are scores of uses for Geon vinyl materials-from rigid sheets and panels to flexible upholstery, wire insulation, vinyl sponge and many more. Helpful technical information is yours

for the asking. Please write Dept. GE-12, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ont.



GEON RESINS . GOOD-RITE PLASTICIZERS...the ideal team to make products easier, better and more saleable.

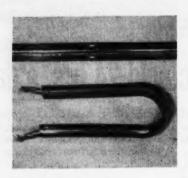
GEON polyvinyl materials . HYCAR American rubber . GOOD-RITE chemicals and plasticizers . HARMON colors



Hot Oil Heater Ups Small Refinery Output

Adapted from the Vapor-Clarkson steam generator this hot oil heater has increased output of a refinery crude distillation unit by 16%. At Oriental Refining Co.'s 3,500 bbl. per day Denver refinery it is reheating 15 gpm. of reduced crude from 630 to 780 F for re-

processing. By pumping the reheated stock back into the column the hourly output has been upped from 60 to 70 bbl. per hr. Fuel for the heater is offgas from one of the thermal cracking units.—Vapor Heating Corp., 6420 West Howard St., Chicago 31, III. 256A



Electric Heater

Incorporates vane construction for air and surface heating.

The new vane-type Calrod electric heater fits into many heating applications including pipe, platen, valve and pump, and process machinery. With a large radiating surface made possible by the 11 in.-wide vane it is rated at 14.3 w.

per sq. in. or 25 w. per linear in.

Heater is manufactured by pressing a Calrod heater against the center of a steel vane defin. thick. The U-shaped depression in the vane contains the heating element and a flat surface is provided with conveniently-located holes for easy mounting. Heater and vane are joined securely by copper brazing.

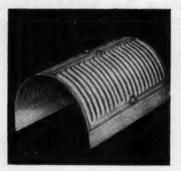
Available sizes range in length from 20 to 100 in., 500 to 2,500 w. for either 115 or 230 v.—General Electric Co., Schenectady 5, N. Y. 256B

For More Information . . .



about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.



Heating Panels

Now can be furnished in a variety of special shapes.

Curved Thermo-Panels, such as that above, now can be furnished to aid in meeting heat exchange requirements. They can be placed around tanks, under troughs; can be used as part of the vessel structure in the construction of tanks, vats, and kettles.

Thermo-Panels are also available in special shapes such as L's and cylinders and in a wide range of materials including steel, stainless steel, monel and other alloys. The finished units are easier to install and clean than standard pipe coils.—Thermo-Panel Div., Dean Products, Inc., 616 Franklin Ave., Brooklyn, N. Y.

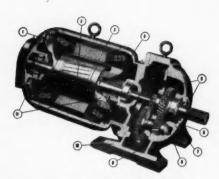
Corox electric heating units now are being offered in continuous lengths up to 25 ft. with an outside diameter as small as 0.230 in. Use of single, low-watt density heaters in lengths as long as 25 ft. eliminates "sets" of two or more heaters requiring additional terminals and wiring at added cost.—Westinghouse Electric Co., 401 Liberty Ave., Pittsburgh 30, Pa. 256D

Bucket steam trap employs balanced valve principle; operates through pressure range up to 250 psi. without adjustments, changing orifices or valves. Suited for process use where load and pressure vary. All internal parts are stainless steel.—Perfecting Service Co., 332 Atando Ave., Charlotte, N. C. 256E



The power you need at the speed you need it . . .

HOWELL GEAR MOTORS



11 reasons why Howell Gear Motors last longer, serve you better

- High-quality insulation Copper-clad rotor Expert craftsmanship

- High-quality coil varnish Leakproof oil seals
- **Duti-Rated Lifetime Gearing**
- Unit case construction with integral bearing housings
- Corner-mounted offset shaft
- 9. Large oil reservoir
 10. Heavy, cast-iron construction
 11. Superior cooling

New dependability, greater starting torque and top efficiency, with output speeds as low as 7.5 rpm. are now available in Howell Gear Motors.

This compact, single-unit motor may well be the answer to your gear reduction problems. Combining the finest in heavy duty industrial gearing with the best in motoring, Howell Gear Motors reduce drive failures and production downtime.

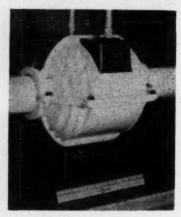
Howell Gear Motors use duti-rated, lifetime gearing, with file-hard tooth surfaces and tough, resilient cores. They are available in all types of enclosures, from 7.5 to 780 rpm. with a capacity range from 1 to 150 hp., in all three AGMA service classifications.

For full information on Howell Gear Motors, contact the Howell man in your area, or write the factory direct for Bulletin GM-1.



HOWELL MOTORS

MOTORS FOR INDUSTRY SINCE 1915



Magnetle Flow Meter

Built for larger lines to meter unlimited flows.

Incorporating all the advantages of electromagnetic flow metering, a new instrument measures unlimited maximum flows in 2 to 8 in, lines. Results are not affected by pressure, viscosity, density or changes in conductivity of the liquid flowing. It is recommended for aqueous solutions, slurries, acids and other corrosives, as well as food and drug products requiring sanitary processing.

In order for the meter to function, the specific conductance of the flowing liquid must be approximately 200 micromhos or more. Output is linear and is directly proportional to the average velocity of the flowing liquid, which in turn is proportional to volumetric flow rate.

Meter consists of a nonmagnetic flow tube with an insulating liner containing flush-mounted metallic electrodes. An a.c. electromagnet surrounds the flow tube.

When conductive liquid passes through the tube, an alternating voltage is set up between the electrodes. As rate of flow varies so does the voltage output to the electronic recorder thereby giving a direct indication of change.

Neither turbulence nor variation in the "flow profile" affect the transmitter. Straightening vanes or straight runs of pipe are not necessary. Over-all accuracy is within ±1% from zero to maximum flow.—The Foxboro Co., Foxboro, Mass.

Hardness Tester

Continuously analyzes and records the hardness of water.

A precise, new analytical method enables the LeMag Durometer to determine continuously the hardness of effluent water from sodium zeolite, ion exchange and hot process softeners. It can also monitor other constituents in water such as phosphate, silica, sugar and chlorine.

Automatic colorimetric titrations performed by the LeMag Durometer are possible through recent advances in analytical methods. For example, on hardness determinations the colorimeter in the Durometer determines the extent to which calcium and magnesium react with the indicator solution.

Once every three minutes a controlled quantity of reagent, buffer and water sample are mixed. Since all quantities remain constant, the water hardness is the only variable.

Calcium and magnesium present in the water react quantitatively with a portion of the indicator solution. After the reaction is complete, the solution contains a mixture of the unreacted blue indicator and the reacted red complex. The colorimeter measures only the concentration of the red complex. If concentration reaches a preset high level an alarm circuit is actuated.—Milton Roy Co., 1301 East Mermaid Lane, Philadelphia 18, Pa.

Transmitter

Converts electrical signal, transmitting pneumatically.

Electrical output signals from sensing elements can be transmitted as pneumatic signals to receiver instruments by using the Foxboro EMF/Pneumatic transmitter. It converts a d.c. voltage input signal into a proportional pneumatic output signal of 3 to 15 psi.

For certain electrochemical measurements such as oxidation-reduction potential or pH an extra highimpedance device such as the Beckman model W amplifier must be used. The d.c. signal output from the amplifier then can be fed into the EMF/Pneumatic transmitter.

Transmitter consists of a magnettor to convert the d.c. voltage into a proportional 2,000 cps. a.c. voltage, a 2,000 cps. voltage amplifier, a rectifier circuit and a direct current-to-air transducer to provide the pneumatic output signal. The d.c. output of the amplifier varies linearly with the voltage input; the transducer is simply one method of utilizing this current output.—The Foxboro Co., Foxboro, Mass. 258C



Electronic Tank Gage

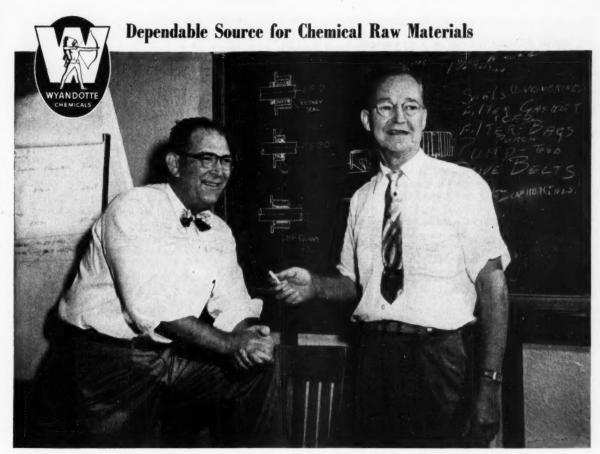
Uses servo-operated probe to measure level within $\pm \frac{1}{16}$ in.

Twice the accuracy of previous automatic or hand gaging methods is claimed for the new Gilbarco electronic tank gage. Measurements are uniformly accurate because there is no float to be affected by variations in specific gravity. Also variations in sheave friction have been nullified.

System includes a sensing element, electronic control box and servo-motor box together with pulley boxes and any remote reading equipment desired.

The sensing element is suspended within the tank by a perforated stainless-steel tape. Tape runs over pulleys to a sprocket on the servo-motor. At the ground level an indicator, calibrated in sixteenths of an inch, is connected to the motor shaft.

A straight-wire antenna projecting from the end of the sensing element penetrates the liquid 1 in in.



Dr. W. L. McCracken (left), director of research for the Detrex Corporation, works out a cleaning equipment problem with Vice President C. F. Dinley.

Detrex, pioneer in cleaning products, is benefiting from the Pluronics. Are you?

As pioneers in the cleaning field, developers of the fabulous new ultrasonic process for production cleaning, and one of the foremost makers of cleaning equipment, Detrex Corporation, Detroit, Mich., is well qualified to evaluate the various raw-material ingredients that go to make up quality cleaning compounds.

"We have found Wyandotte Pluronics valuable in our alkaline cleaning preparations as well as in other formulations used for the preparation of metal surfaces," says Dr. W. L. McCracken, Detrex director of research. "We particularly like them for their non-foaming qualities in alkaline-type metal cleaners. They also provide in-

creased detergency, have free rinsing characteristics, and give the formulations stability over a wide range pH. By introducing the Pluronics in some of our products, we eliminated the need for anti-foaming agents and, at the same time, saved a lot of service work.

"We have found Wyandotte heavy chemicals and Wyandotte service most satisfactory over the years," states Dr. McCracken.

Whether you make metal cleaners or mechanical-dishwashing compounds, you will find the Pluronics* are not just another series of nonionics. Actually, they are so unique, so different that, unless your evaluation takes in their over-all advantages and better all-around

balance, you may not have visualized their full potential. If you are not already using the Pluronics, write us for data and free samples, giving as much detail on your projected use as possible. Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.

* REG. U.S. PAT. OFF.



HEADQUARTERS FOR ALKALIES

Soda Ash • Caustic Soda • Bicarbonate of Soda • Chlorine Calcium Carbonate • Calcium Chloride • Glycols • Chlorinated Solvents • Synthetic Detergents • Agricultural Insecticides Other Organic and Inorganic Chemicals Radio frequency signals are generated within the electronic control box and carried to the antenna by a cable attached to the stainless-steel tape. Simultaneously, return signals enter the control box, are amplified and fed to the servo motor.

Movement of liquid away from the antenna strengthens the return signal; liquid rising on the antenna weakens the signal. This variation in signal actuates the servo motor to keep the probe in the same position relative to the surface of the liquid.—Gilbert & Barker Mfg. Co., West Springfield, Mass. 250D

Dew Point Hygrometer

Checks continuous sample flow for dew point temperature.

Dew point temperatures can be measured within ±1° C over a range from ±18 C to -50 C using the new 900-1 dew-point hygrometer. Instrument handles a continuous flow of sample between 500 and 2,000 c.c. per minute. at pressures between ½ and 1½ atm.

An electronic system comprising photocells and an oscillator continuously observes a miniature mirror on which the dew is formed. Temperature is read out on a fine wire thermocouple that is integrated with the mirror to permit either visual or recorded results. An automatic timer clears the mirror every six minutes.—Burton Mfg. Co., 11201 West Pico Blvd., Los Angeles 64, Calif. 260A

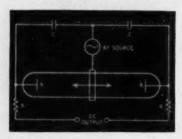
Oxygen Analyzer

Measures dissolved oxygen accurately and continuously.

Using a standard Beckman oxygen analyzer as the keystone, Beckman now has come out with an instrument to give accurate and continuous measurement of dissolved oxygen. It is suited for use on waste disposal, in sewage and water treatment plants, in manufacture of petroleum products, solvents and chemicals.

Model 1A3B combines in one

unit a simple physical scrubbing mechanism and the analyzer. The instrument is designed to read percent saturation directly, but scales are also available calibrated in parts per million, if desired. It can be used with any standard potentiometer recorder or indicator.—Arnold O. Beckman, Inc., 1020 Mission St., South Pasadena, Calif. 260B



Transducer

Based on gas-discharge tube gives output voltage variable with motion.

Rooted in a new concept, the T-42 transducer is of particular interest where little or no mechanical force or inertia is available for dissipation in the measuring device. It can convert a physical displacement, a dielectric change or an appropriate impedance change into a corresponding electrical signal. Characteristics of this transducer are high sensitivity, excellent linearity and resolution, high output levels, good static and dynamic response.

Operation of the transducer depends upon the voltage developed between two electrodes within a gas discharge vessel when the vessel is exposed to a radio-frequency electric field. Symmetry of the two electrodes with respect to the electric field leads to a zero output voltage. Any slight asymmetry, due to an unbalanced field or any other condition, leads to a potential difference between the two electrodes.

An example of physical displacement converted into a voltage change is shown in the sketch above. As the ring electrode, which surrounds the glow discharge tube, moves it produces asymmetry and a resultant voltage change.—Decker Aviation Corp., 1361 Frankford Ave., Philadelphia, Pa. 260C

Thermistor Controller

Combines accuracy, stability and ease of maintenance for temperature control.

Using a thermistor sensing element the new Series 560 temperature indicating controller is said to be highly stable and accurate. Operating in the 0-600 F range it will be manufactured in both an industrial and an easily portable laboratory model.

Thermistors depend upon their ability to exhibit changes in electrical resistance with variations in temperature. In turn measurement of the associated changes in voltage or current serves as an indication of the temperature.

Because the thermistor in the Series 560 indicating-controller undergoes a 1,000-fold resistance change between 100 and 600 F, response accuracy is well within 0.25% of full scale. Power source is 115-v., 60 cycle a.c. but control accuracy remains unaffected at any line voltage between limits of 95 and 130 v.

Control and indicating circuits are separate. Thus, control accuracy is held even if the indicating circuit should become inoperative. Use of a standard, ruggedly-constructed meter means that control accuracy is not affected by moderate shock or vibration.—Fenwal Inc., Ashland, Mass, 260D

Explosion-proof level indicator employs the standard Telstor electronic unit that measures mass or level of liquids, viscous fluids, powders and granular solids. It's available in several combinations to suit different applications.—Fielden Instrument Div., Robertshaw-Fulton Controls Co., 2920 North Fourth St., Philadelphia 33, Pa. 260E

Pressure transmitter, strain-gage type, built with stainless steel pressure chamber is well suited to chemical process applications. Teledyne transmitter has high frequency response yet is insensitive to vibration—Taber Instrument Corp., North Tonawanda, N. Y. 260F

WHY IT PAYS TO BUY ALLOY STEELS FROM US



• You know what you're getting when you buy alloy steels from U. S. Steel Supply. For with each lot you purchase, we furnish a personalized data card. This card charts the guaranteed minimum hardenability and gives analysis information and recommended tempering and working temperatures. You are thus assured of getting in full measure the tensile strength, fatigue resistance, ductility and toughness that your design requires. We can assure maximum machinability too, for we adhere to unusually strict metallurgical standards in the purchase of all our alloys.

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ered how alloy steels might contribute to your production of a better product at a cost that might be even lower than at present? If not, it will pay you to call U. S. Steel Supply. One of our salesmen will gladly study your specific problems and, if alloy steel will do a better job for you, he will recommend the best alloy and see that you get it promptly.

Call us for: USS Carilloy alloy steels—hot rolled rounds, cold finished rounds, squares, hexagons, "FC" (Free-Cutting) rounds; USS Carilloy Aircraft Quality hot rolled rounds and flats and cold finished rounds, squares, hexagons, flats.

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208 So. La Salle St., Chicago



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UNITED STATES STEEL

Two-Stage Pump

For clear liquids operates efficiently, maintains easily.

On Goulds new series of twostage pumps a unique labyrinth diaphragm is used to give thrust balance; opposed impellers assure hydraulic balance. Bearing spans have been kept short, resulting in savings on space up to 50% compared with equivalent pumps.

Wide interchangeability of parts keeps spare parts inventories at a minimum. For example, only two shaft and rotating parts assemblies are needed to cover all five available pump sizes. And casings are split horizontally so that rotating parts can be removed without disturbing piping connections.

Furnished with either conventional stuffing boxes or mechanical seals the pumps can provide heads to 1,000 ft. and capacities to 1,000 gpm.—Goulds Pumps, Inc., Dept. CE, Seneca Falls, N. Y. 262A



Plastic Pipe

Tough, resists impact, favorable cost.

Dur-Ace pipe is the 8th addition to American Hard Rubber's line of corrosion-resistant pipe, fittings and tubing. Capable of handling most common corrosives, Dur-Ace is a rigid plastic pipe with exceptional impact resistance and toughness.

After four years of development including successful field installations of thousands of molded fittings and parts, American lists the following highlights for its product:

Light-weight, odorless, tasteless and non-contaminating.

- Excellent resistance to all inorganic acids and alkalis; exception, a few strong acids.
- Generally satisfactory for petroleum products.
- Limited resistance to organic solvents.
- Low rate of moisture absorption.
- From -40 to 170 F good strength, rigidity and chemical resistance.

Pipe is now supplied in sizes from ½ to 2 in., in standard 20-ft. lengths with choice of two wall thicknesses. Fittings are available with standard IPS threads.—American Hard Rubber Co., 93 Worth St., New York 13, N. Y. 262B



Graphite Pump

Assures virtually leak-proof operation.

A virtually leak-proof seal has been incorporated in the re-designed line of Impervite centrifugal pumps. These impervious graphite units are suitable for intermittent or continuous handling of corrosives such as hydrochloric acid, nickel plating solution, chlorinated organics, rayon spin bath, etc.

Other design changes include the use of over-sized bearings and a heavy stainless-steel shaft. The shaft and impeller are made as two separate, independent components to permit quick, simplified and inexpensive maintenance.

One group of these pumps has already been in operation for six months handling chlorinated organic acid at 75 C without need for any maintenance, it is said.

Six models of this pump are available in capacities from 25 to 200 gpm. at heads of 20 to 100 ft.—Falls Industries, Inc., 31915 Aurora Rd., Solon, Ohio. 262C

Stainless-Steel Valves

Now offered at lower cost than previously.

Using chrome-plated plugs Rock-well is offering a new line of Nord-strom valves than are priced lower than the previous stellite-protected stainless-steel valves. They are suitable for most services now handled by the more expensive predecessor; are recommended for food, plastic, sulfite pulp and chemical plants.

The chrome-plating backed by stainless steel offers double protection against scoring, galling and other effects of corrosion. New valves are offered in the same sizes and types available in the higher-priced Rockwell-Nordstrom line.—Rockwell Mfg. Co., 400 North Lexington Ave., Pittsburgh 8, Pa.

Proportioning Pump

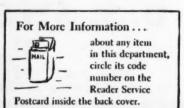
Is packless, positivedisplacement, fullyenclosed unit.

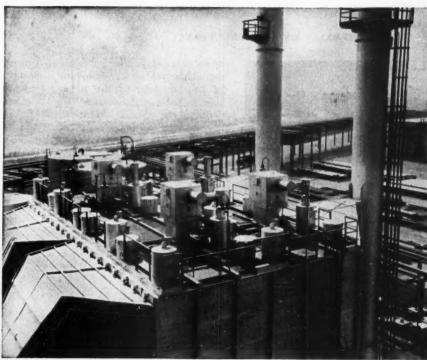
Termed by its maker "the meter that pumps" the Hills-McCanna-Meter is a new proportioning pump that meters precisely from 5 cc. to 6.gph. It delivers a pulse-free flow, is easily adjustable by light finger pressure while the pump is operating or stationary.

Design of the pump is said to be unique in that the pumping element is sealed and absolutely leak-proof. There are no stuffing boxes or packing glands

or packing glands.

Although completely enclosed, the unit is easily serviced. It can be controlled automatically utilizing instrument air signal.—Hills-Mc-Canna Co., 3025 North Western Ave., Chicago 18, Ill. 262E





Nothing Succeeds like Success

... Buell 'SF' Electric Precipitators PROVE IT AGAIN!

Spectacular on-the-job performance started engineers talking...and it's been music to our ears ever since.

Our engineering friends have marvelled at low maintenance costs... at brand new efficiency records... at the wide range of different and complex dust recovery problems that are being solved by Buell's 'SF' Electric Precipitators.

We will be happy to demonstrate the finer points at any time. Such standard Buell features as continuous rapping...convenient remote control from a central switchboard...the proved efficiency of the exclusive Buell Spiralectrode, are all elements of simple overall design.

Dozens of Buell 'SF' Electric Precipitators are already operating or in the works. Get the complete facts now. Write for our informative Brochure "The Collection and Recovery of Industrial Dusts" which tells about all three Buell Systems of industrial dust recovery. Write today! Buell Engineering Company, Department 12-L, 70 Pine St., New York 5, N. Y.





20 Years of Engineered Efficiency in

DUST RECOVERY SYSTEMS



Ceramie Veneer

Five times lighter than any other similar ceramic.

Declaring that it may do for the structural clay industry "what plywood does for the lumber industry," W. W. Robinson displays a sheet of Vitrineer ceramic veneer. Ability to resist crazing, chemical attack and high temperature make it a likely prospect for interior surfaces in chemical plants.

Vitrineer is said to be the first successful, large, thin ceramic sheet. Previous attempts have failed because of shrinking, warping and distortion. But Vitrineer is flat like plate glass, is 1-in. thick, weighs 4 lb. per sq. ft., comes in sizes 12 x 16 and 16 x 24 in. It can be cut with a masonry saw or a carboloy scribing tool.—Robinson Brick & Tile Co., 500 South Santa Fe Dr., Denver, Colo.

Stainless Steel

Formulated and approved specifically for welded construction.

According to a recent report of the ASME Boiler Code Committee, Carpenter stainless steel 20 Cb now is approved for the construction of welded pressure vessels. Included in the study, ASME Case 1188, are nine specifications and fabricating procedures that are the bases for approval.

Grade 20 Cb stainless steel is formulated to permit fabricated pieces being placed in service in the as-welded condition. Columbium in the alloy minimizes the precipitation of carbides during hot working. Thus, welding fabrication can be used on equipment that is too large for subsequent annealing.

Any of the standard electric arc and resistance welding processes are suitable for Carpenter 20 Cb. Oxyacetylene welding is not recommended.

Furnished in sheets, plates, pipes, tubing and bars, this alloy is used in constructing mixing tanks, heat exchangers, process piping, bubble caps, metal cleaning and pickling tanks, spray pickle equipment, etc.—The Carpenter Steel Co., Alloy Tube Div., Union, N. J. 264B

Mastie Coating

Used over insulation, permits breathing.

Designed to permit passage of entrained moisture through the coating, Erkote 6X mastic can be used over all types of insulation on heated equipment. It has excellent resistance to most acids, alkalies and hot moist vapors.

This breathing-type mastic is a blend of selected petroleum and gilsonite asphalts, synthetic rubber, inert inorganic fillers and a small percentage of selected asbestos fiber for reinforcing. Being a cut-back asphalt, it contains no water to corrode the metal in supporting bands and wires.

After a reasonable curing time, Erkote 6X will not support its own combustion. When the source of flame is removed, the material is self-extinguished immediately. — Earl Paint Corp., 240 Genesee St., Utica 2, N. Y. 264C

Industrial Siding

Fabricated of aluminum for attractive, low cost structures.

A trim, attractive appearance is offered for low-cost industrial buildings by installing Alcoa's new ribbed, industrial siding, it is claimed. The embossed surface produces a stuccoed effect that diffuses light.

Intended primarily for frame type

structures it can also be used as facing sheet on concrete-block buildings. By using two layers of aluminum siding with a center layer of glass-fiber insulation the insulation equivalent of a 24-in. brick wall is obtained.

The new siding is available in 0.032-in. thickness and lengths from 5 to 18 ft. in 6-in. increments. —Aluminum Co. of America, 745 Alcoa Bldg., Pittsburgh 19, Pa.

264D



Insulating Rope

Made of asbestos, offers more linear feet per pound.

For effective insulation of curved and irregular piping, bends, fittings, valves and expansion joints you can use this light-weight Caposite asbestos rope.

Made of long-fibered asbestos rovings, it contains no organic reinforcing fibers. The rovings, twisted to the correct diameter, are retained within a braided reinforcing jacket of asbestos yarn.

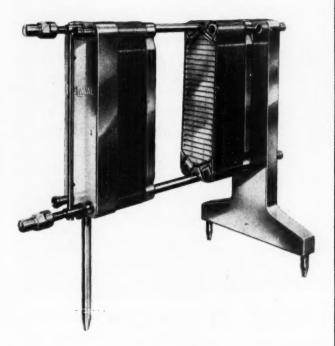
Caposite rope insulates effectively up to 1,200 F, can be removed and reapplied repeatedly at temperatures up to 750 F. It is available in 100-ft. coils, in diameters from ½ to 2 in.—North American Asbestos Corp., Board of Trade Bldg., Chicago 4, Ill.

For More Information . . .

about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.

GET ALL 5 ESSENTIALS



In addition, De Laval Heat Exchangers have other advantages which make them the finest equipment of its kind ever offered to American industry for pasteurizing, heating, cooling and regeneration. Bulletin PHX gives details. Write for it...today!

The De Laval Plate Heat Exchanger

- Provides maximum heat transmission—
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- Is easy to assemble and disassemble.. with means for precision tightening—
- 5. Is built to withstand high pressures.



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GUIDED TOUR CONTINUED



INDEX Annual editorial index for 1954..... 271 PICTURED FLOWSHEET New phosphoric—polyphosphates plant..... 320 CHEMICAL ECONOMICS Should you plan to expand in 1955?..... 327 NAMES IN THE NEWS Names that made news last month..... TECHNICAL BOOKSHELF Twelve newcomers for your reference shelves. . 340 FIRMS IN THE NEWS Who's doing what among your suppliers..... 352 READER SERVICE You can get more information free..... 407 TECHNICAL LITERATURE

New literature from the manufacturer..... 418

Novel design . . .

. . . features Virginia-Carolina's new phosphoric acid and sodium tripoly plant in Ohio. Here's a pictured flowsheet of an unusual operation. (p. 320)



Plan to expand in 1955?

There's no pat answer, of course. But first take a long, hard look at construction cost trends, supply of capital, new depreciation rules. (p. 327)



Losing your friends?

Could be if you aren't keeping up with what they're doing and where they're going. Names in the News keeps tabs on what's happening to engineers. (p. 334)



New technical literature . . .

You can now get—free and fast—literature on any subject in your field. Keep your technical files up to date. (p. 418)



Join READER SERVICE on page 407



WELDING with Everdur Rod produces a fast and low-cost joint without structural distortion. Note that alternate sides of the sheets are rolled and welded to form a leak-proof channel.

> FINISHED HEAT EXCHANGER - All Everdur construction except fitting flanges and end covers.



400 sq. ft. spiral heat exchanger made of Everdur Sheet

The spiral heat exchanger shown drel and rolled up like the baker's fa- be happy to tell you more about above is in service at the Pennsylvania Sugar Division of The National Sugar Refining Co., cooling hot sugar syrup with river water as the coolant.

No pipes or tubes are used in this unit. The spiral exchanger, made by American Heat Reclaiming Corporation, New York, is fabricated of 3,100 pounds of Everdur* sheet, 60" wide x .1019" thick.

Two strips, each 60" wide x 40' long, are fabricated by butt-welding 60" x 10' sheets. Spacer studs of Everdur are stud-welded to each strip. The strips are joined in a man-

welds are made with Everdur-1010 Ltd., New Toronto, Ontario. Welding Rod using the inert-gas Most. U. St. Pat. Off. tungsten-arc method.

Everdur - available in sheets, plates, rods, wire, tubes, electrical conduit and casting ingots - is only one of the Anaconda family of copper alloys which offer a wide range of physical properties and forms for designing industrial equipment. We'll

miliar "jelly roll" to make a double Everdur and other Anaconda Copper concentric spiral. The cooling water Alloys and their fabricating methods. and the syrup travel in a spiral path Address: The American Brass Com-40 feet long and in full counterflow. pany, Waterbury 20, Connecticut. In Except for the stud-welding, all Canada: Anaconda American Brass

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automatic screen centrifuges
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Avail yourself of our experiences to find the right centrifuge for your material.

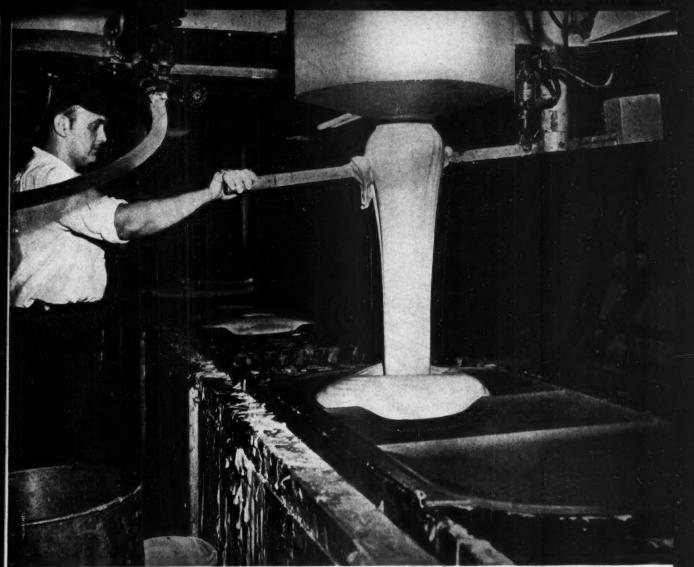
Ask for our prospectus!



KRAUSS-MAFFEI MUNCHEN

Germany





This frothing unit pours liquid latex into molds.

Demineralized water helps GOOD YEAR' maintain Airfoam quality—and saves money, too!

The minerals dissolved in raw water carry electrolytic charges. If such water is used for latex dispersions, the rubber coagulates prematurely... causing excessive waste.

Goodyear tried distilled water...until increased production overtaxed the steam plant.

So Goodyear engineers looked into ion exchange. After evaluating various demineralizers, they selected Permutit resins and equipment.

Here's what they report after 4 years of continu-

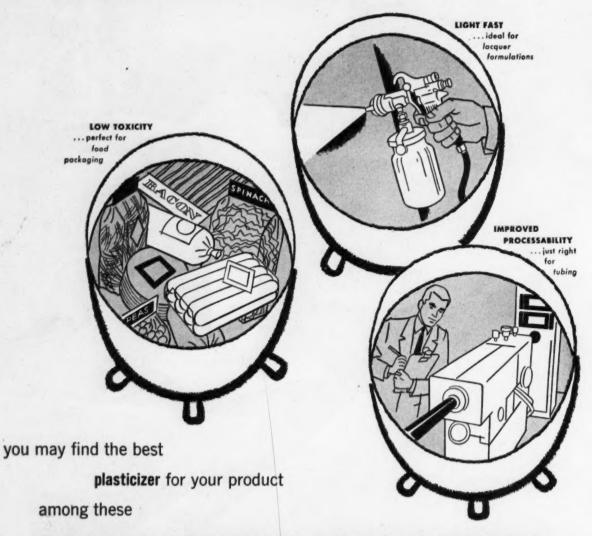
ous operation: "The Permutit units reduce dissolved solids from 165 to 3 ppm and supply iron-free water of controlled alkalinity. It has proved to be higher in quality than distilled water—at a considerable saving!"

Better water may solve your problem. Write to learn what Permutit can do to help you. The Permutit Company, Dept. CE-12, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

*T.M.'s The Goodyear Tire & Rubber Company

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS

PERMUTIT



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Acetyl Triethyl Citrate: Highly recommended as a plasticizer for cellulose acetate and other cellulosic derivatives. Less volatile than many plasticizers commonly used with cellulose acetate. Results in improved heat and light stability.

Triethyl Citrate: Recommended as a solvent plasticizer for cellulose acetate and other cellulosic derivatives. Has low solubility in oil. Ideal for products which must be resistant to oil and grease.

Acetyl Tributyl Citrate: Recommended particularly for heat and light stable polyvinyl chloride film, sheeting and extrusions. Extremely low in

toxicity, it lends itself to the production of food wrappings and other products in which toxicity is a factor.

Tributyl Citrate: Recommended for vinyl film, sheeting and extrusions. This low-toxicity plasticizer is especially desirable for food packaging, beverage tubing, hospital sheeting and apparel which may contact the skin. Also an effective anti-foaming agent, particularly where toxicity is a factor.

For additional information about these products, write for Technical Bulletin #31, "Pfizer Citric Acid Esters as Plasticizers."

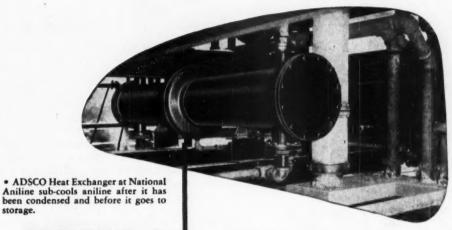
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WHERE A
HEAT
EXCHANGER
MUST BE
GOOD

 ADSCO Heat Exchanger (insulated) above vacuum drier at National Aniline condenses organic acid vapor in tubes with water or brine in shell. Exchanger equipped with shell expansion joint. The ADSCO Heat Exchangers shown on this page are installed in the Buffalo, N. Y., plant of the National Aniline Division of Allied Chemical & Dye Corporation. The manufacturing processes of National Aniline require engineered equipment of the highest caliber. . . . ADSCO, in business since 1877, offers the chemical processing industry a complete line of carefully-engineered heat exchangers built to customers' specifications or to our recommended designs. Inquiries are cordially invited.

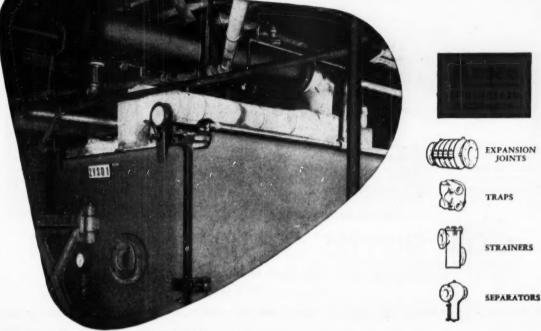
AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES

NORTH TONAWANDA, NEW YORK

PLANTS

NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.



CHEMICAL ENGINEERING—December 1954

The Biggest News in tank cars since the all-welded car!



A million-dollar press was needed to make this new car possible! And yet—whether you follow the trend to leasing, or whether you buy—you get DURADOME benefits at no extra cost. Stronger... easier to clean... easier to apply lining. Get all the facts on the new DURADOME now from your Shippers'



improved 4 ways

I *Flued Dome . . . dome base actually pressed out of heavy steel plate - eliminating fillet welds and dome shelf fer greater structural strength and corrosion resistance.

2. Pressure-type Construction...
uses complete "ring-sections" or
cylinders to build up the tank.
That means heavier steel all the
way around for greater durability.

3. All-welded Insulation Jacket (when required) . . . angles and bolts completely eliminated. Streamlined—more weatherproof—needs less maintenance.

4. Standardized Underframe...
the same, all-welded underframe
for tanks of all standard types and
capacities. Provides flexibility of
use; more economical maintenance!



The DURADOME car is available for lease or sale through . . .

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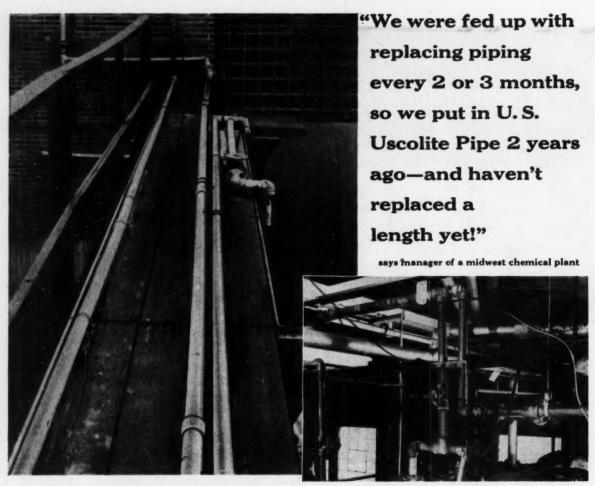
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Which of these is your pumping problem? SUGAR CARBON HYDRAULI MOLASSES HYDROLUBE FURFURAL LIQUOR O 0 Ö O LIQUID SULPHUR LINSEED EDIBLE VINYL CARBON RESIN SOA CONDENS ETRACHLO OILS 0 CAUSTIC CHOCOLAT PAINT Name just about any fluid you consider 0 O .0 "hard to handle" and we will show you a 0 De Laval pump that will do the job effi-WASTE ciently and at low cost. GRINDER FUE GLYC De Laval IMO and CPO pumps have LIQU solved problems on a wide range of prod 0 O ucts-hot or cold, acidic or alkaline, viscous or corrosive, clear or filled with suspended solids. IMO and CPO models are BENZIN ASPH/ available for early delivery. Your De Laval representative is an ex-0 perienced application engineer. Consult him on your pumping problems or write today for literature. CALCIUM CANE WASH IMO PUMPS 0 O capacities to 750 gpm INK 1500 psig 0 0 capacities to 2000 gpm heads to 200 feet



DE LAVAL STEAM TURBINE COMPANY 803 Nottingham Way, Trenton 2, New Jersey



A chemical plant in Illinois makes sodium hypochlorite, for use in bleaches, laundry disinfectants, water purifiers. Until over 2 years ago, the piping that carried the chlorine and hypochlorite would fail every 2 or 3 months. This was considered a routine performance—until U.S. Uscolite® plastic pipe was installed. Uscolite has now been on the job for over 2 years and shows no sign of deterioration and we have eliminated our troubles with metallic contamination!

Another big point about Uscolite, says the factory manager, is that a part of the pipe is exposed year after year to the weather on an outside truck loading station. Any damage? "No, none whatever."

Uscolite is a product of United States Rubber Company. This great plastic is available not only in piping, but in pipe fittings, valves, and sheet stock for fume ducts. Uscolite is extremely light in weight, yet has very high impact strength. It resists acids, salts, alkalies, fumes—inside and out.

View of U.S. Uscolite Pipe carrying bleach on outside truck loading station. Years of exposure to every kind of weather have had no effect on this piping. (Right) Uscolite pipe carrying bleach to storage tank.

Rid yourself of piping problems. Next time you require new piping, or replacement of old piping, remember Uscolite. Call any of the 27 "U. S." District Sales Offices or write address below.

Uscolite pipe and fittings are made in the broadest and largest line of stock sizes of plastic pipe on the market. Sizes follow:

● Molded fittings in ½" through 4" I.P.S. ● Molded flanges ½" to 6" I.P.S. ● ½" to 3" Uscolite diaphragm valve (Hills-McCanna). ● Header pipes in 2", 3", 4", 6" pipe sizes. ● Pipe in standard wall dimensions and extra heavy wall dimensions in ½" through 6" pipe sizes.



"U.S." Research perfects it . . ." U.S." Production builds it . . . U.S. Industry depends on it.

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or torrent

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gives you the capacity you need... the value you want!

When you want to move a few gallons of fluid . . . or up to 2800 cpm with heads to 650 feet, it will pay you to investigate the Ingersoll-Rand MOTORPUMP.

The MOTORPUMP is compact and efficient. Size-forsize it stands out by consistently moving more gallons per kilowatt of power used.

In value, too, the MOTORPUMP is a best buy. From impeller locknut to motor bearings, every MOTORPUMP is designed from experience to do the toughest job—for the longest time—at the lowest maintenance cost.

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MOTOR PUMP

 End-to-end, top-to-bottom, the MOTORPUMP is crammed with design features and construction advantages that make it a better buy.

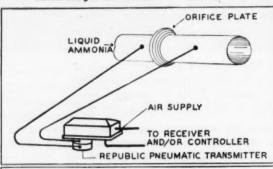


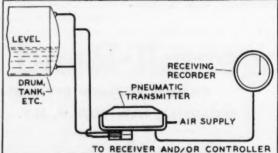
Republic PNEUMATIC TRANSMITTERS

...Your Best
Solution to
Tough Metering
Problems
Like These:

LOW DIFFERENTIAL FLOW MEASUREMENT

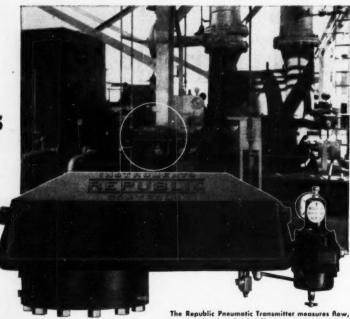
When pressure drops in flow lines must be kept small—as in the discharge of blowers—low range Republic Transmitters offer the most practical answer to flow measurement. For only with Republic Transmitters can you get differential ranges as low as 0-0.6-in. H₂O at static





IF YOU HAVE A PROBLEM

involving the measurement of FLOW, PRESSURE, LEVEL OR DENSITY with pneumatic transmitters . . .



The Republic Pneumatic Transmitter measures flow, pressure, level or density. The pneumatic output can be used to operate reading instruments and as the measuring impulse to an automatic controller.

pressures to 15 psi and 0-2.5-in. H_2O at pressures to 1000 psi. This low range feature permits the use of devices producing a minimum differential; accurate force-balance measurement and control is possible with back-pressure on blowers, for example, held to a negligible figure.

METERING VAPOROUS LIQUIDS

Repulic's low ranges provide the key to successful measurement of easily vaporized liquids, too. Take the flow of liquid ammonia through an orifice as an example. By using an orifice producing a small differential drop, you avoid flashing the liquid into gas and getting an inaccurate measurement. And since the Republic Transmitter is a force-balance instrument, there are no problems of liquid seals, purging or overrange blowing the sealing liquid into flow lines.

LIQUID LEVEL MEASUREMENTS UNDER PRESSURE

This job requires an instrument with a narrow range span and considerable range suppression. High pressure, low range Republic Transmitters are available for just this kind of measurement. For accuracy and close control, range suppressions up to four times the range span are possible i.e., a Republic Transmitter with a 0-100-in. H₂O range can be suppressed to operate between any 20-in. H₂O span within the full 100-in. range.

Write for Data Book 1004. It describes and illustrates 22 different Republic Transmitter models, gives hook-ups, ranges, performance data. Write for a free copy.



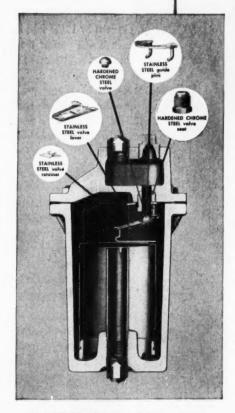
REPUBLIC FLOW METERS CO. • 2240 Diversey Parkway • Chicago 47, Illinois

You will always get better results by putting a Steam Trap on each Steam Coil, Chest or Unit

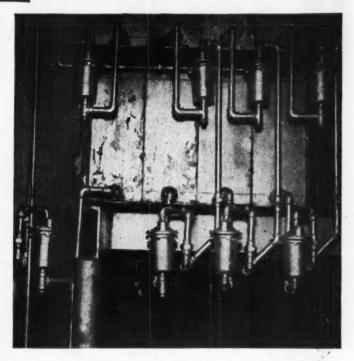
EXAMPLE

Dryer Temperatures at Guelph Creamery, Guelph, Ontario.

WITH GROUP TRAPPING (5 steam traps for 10 coils)	225°F	
WITH BLOW-THROUGH (no steam traps)	250°F	
WITH ARMSTRONG UNIT TRAPPING (10 traps—one on each of 10 coils)	309°F	



One of the big advantages of Armstrong traps is LOW MAINTENANCE. Mechanisms in low and medium pressure traps identical in design, workmanship and materials to those in 900°F, 900 psig traps.



• The example at the upper left is simply one of thousands that bear out the benefits of "Armstrong Unit Trapping".

When you analyze it, the reason is quite obvious. No two steam coils, chests, chambers or machines will condense steam at exactly the same rate under operating conditions. There is a greater pressure drop in the units that condense the fastest. Steam will backflow through a common drain line from a higher pressure unit to a lower pressure unit. This blocks off flow of air and retards condensate flow from the lower pressure unit. On the other hand, if you separate each unit with its own trap, that can't happen.

You will always get higher temperatures and lower production costs with unit trapping. Ask your Armstrong Representative about it, or write:

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FREE-STEAM TRAP BOOK

If you don't have a copy of the 44-page Armstrong Steam Trap Book, we'll be glad to send you one. No obligation.



ARMSTRONG STEAM TRAPS

KING SIZE



This giant 37 ton Cat Poly Reactor is one of 4 units shipped to a large petroleum refinery in the State of Washington. It is 4'-31/2" in diameter by 32'-0" long and has a 13/16" thick shell. Each of its 8" thick heads is attached to the shell channel with 28 special alloy stud bolts 23/4" diameter by 151/4" long having nuts 41/4" across the flats. Into the 53/4" thick tube sheets 190 tubes, 21/2" O. D., No. 5 gauge and 30'-0" long, are rolled and seal welded. Designed for 1,230 lbs. pressure on the tube side, the reactor was completely X-rayed and stress relieved.

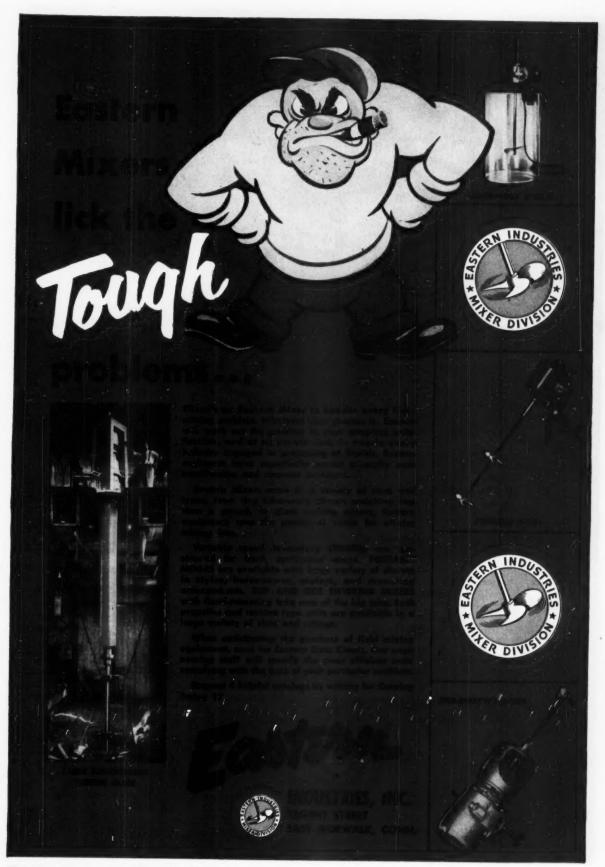
Vogt, a leading builder of shell and tube reactors for poly plants, has the competently skilled personnel and modern mechanical facilities with which to provide heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, and related industries.

Reactors ... by Voqt

A bulletin describing the wide range of heat transfer equipment built by Vogt is available upon request.

HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.



CHEMICAL ENGINEERING—December 1954



C & 1 can now license the new CSC Stengel Process to users and furnish complete plants to produce crystalline ammonium nitrate (33.5% N). Due to simplicity of design, capital and operating costs of these plants are substantially less than similar plants using prilling and granulating processes.

FREE FLOWING In this process, ammonium nitrate of any desired particle size can be produced in a single step. Actual spreading tests in the field have proved that this



Solidified ammonium nitrate sheet is broken into small bits by rotating spoke shaft.

crystalline ammonium nitrate is completely free flowing with a more controllable flow than competitive products.

NON-CAKING This new exclusive process produces a very low-moisture material permitting satisfactory long term storage. The coating on the particles reduces to an absolute minimum the tendency of ammonium nitrate to absorb moisture.

C & I ammonium nitrate plants using the Stengel Process can also produce limed ammonium nitrate (20.5% N) and ammonium nitrate sulfate (26.5% N). These plants are constructed at a fixed price with production and efficiencies guaranteed.

C & I can also furnish nitric acid and complex fertilizer plants (using PEC process) on this same basis.

Specialists in



Processing Ammonia

THE CHEMICAL AND INDUSTRIAL CORP.

CINCINNATI 26, OHIO

December 1954—CHEMICAL ENGINEERING



This pipe would last 203 years on a diet of hot hydrochloric acid

Handling corrosive fluids may be forcing you to pay more than your share of industry's \$6,000,000,000 annual bill for the perpetual war against rust.

PYREX brand "Double-Tough" glass pipe can help you cut your corrosion losses.

This pipe carrying 5% hydrochloric acid at 212° F. loses only .0003 inch of its thickness in a year. At that rate it would take over 200 years to eat away 30% of the wall thickness. It would take over 600 years to eat completely through the pipe.

PYREX pipe not only resists eating away by hard-to-handle fluids. It's also easy to flush clean. Even sticky substances and organisms won't adhere to its hard, smooth surface. Its transparency is often important, too. You can see what's going on inside—spot trouble in the making.

You don't have to worry about breakage. Pyrex pipe is called "Double-Tough" because all fittings and flanged ends are tempered. This makes them 2½ to 3 times stronger than ordinary glass.

Easy to plumb

Your own men will find no difficult problems in installing and maintaining Pyrex pipe. We maintain balanced stocks ranging in size from 1" to 6" I.D., including fittings to match the needs of most layout requirements and adapters for hooking Pyrex lines in with other plant equipment.



SCALE DEPOSITS which impede heat flow do not form on the hard, smooth inside surface of the PYREX pipe in this heat exchanger.



You can see what's happening in PYREX brand glass fractionating columns. No corrosion. No contamination.

FREE BOOKLETS: Send the coupon or write for copies.

This illustrated "Installation Manual" describes the simple procedures involved in laying out and plumbing PYREX brand glass pipe.

This catalog describes the full line of PYREX pipe and fittings, including spacers, adjustable joints, traps, and adapter connections.



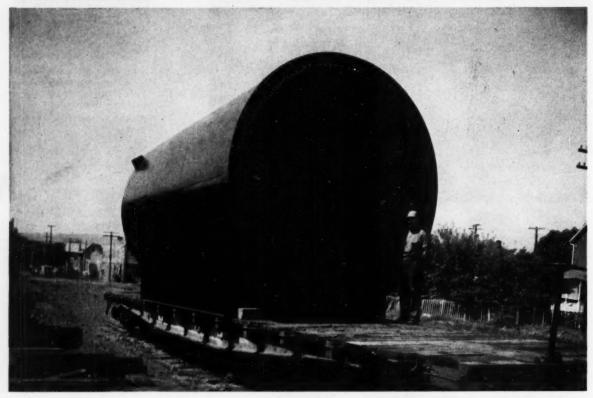


CORNING GLASS WORKS
112 CRYSTAL ST.
CORNING, N. Y.

Corning means research in Glass

and a copy of the PYRE)	of the PYREX pipe Installation Manual [C pipe Catalog]. I would also like mor
information on heat exc	hangers 🗌 and fractionating columns 🗌
Name	Title
Company	***************************************
Address	***************************************
City	Zone State

IT'S VULCAN FROM THE BEGINNING



TO THE END

Shown above is a 12'x22' combustion chamber, for use with a 12'x175' two tire Vulcan rotary kiln. When fully assembled it will be used for the production of titanium oxide. This is just one of the many times that The Vulcan Iron Works has been called upon to design and build a complete unit. A complete unit that has been designed, and is being built to give maximum performance with a minimum of maintenance.

When you build or re-build, contact Vulcan of Wilkes-Barre. The manufacturing facilities are of the latest, and their engineering department is fully staffed to design all types of complete installations. Why don't you let Vulcan, their engineering staff, and their 105 years of experience work for you. Estimates, constructive suggestions, and preliminary drawings will be furnished (as far as possible) without obligation. Write for Bulletin A-442 on Rotary Kilns, Coolers, Dryers, Retorts and other dependable processing equipment today.

Any information on items listed below will be sent to you immediately:

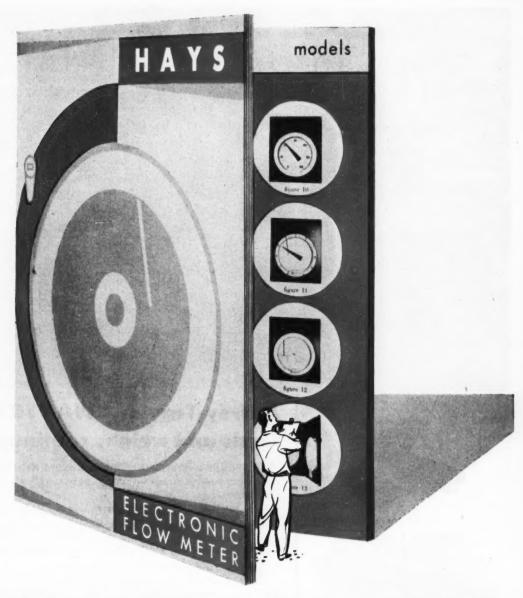
Rotary Kilns, Coolers and Dryers Rotary Retorts, Calciners, Etc. Improved Vertical Lime Kilns Automatic Quick-Lime Hydrators Briquetting Equipment Open-Hearth Steel Castings Heavy Duty Electric Hoists Self-Contained Electric Hoists Cast-Steel Sheaves and Gears Diesel Locomotives Electric Locomotives and Larrys Steel Plate Fabrications Hydraulic Presses

VULCAN IRON WORKS

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A guide to better flow metering

Here's a new fact-filled, technical booklet that tells you feature for feature how the new Hays electronic flow meter excels.

Electronic operation—provides maximum accuracy ($\frac{1}{4}\%$ of full scale differential), and speed (4 seconds for full scale pen travel).

Mercuryless transmitters—rupture-proof metallic bellows for differential pressure measurement.

Continuous integration — motor-driven, continuous mechanical integrator is extremely accurate even on rapid load changes.

Other features include powerful motor, easy readability, accuracy unaffected by normal temperature changes, optional explosion and weather-proof transmitter.

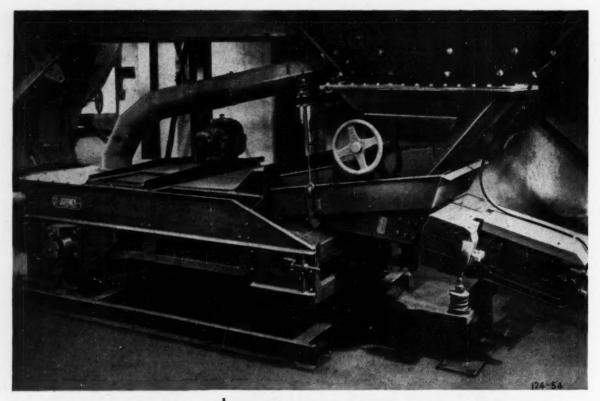
Write for bulletin 54-1074-222 and get the important facts.

Automatic Combustion Control Bailer Panels • CO₂ Recerders Variflew Meters and Veritrol Gos Analyzers • Dreft Geges Combustion Test Sets Electronic Oxygen Recorders

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ELECTRIC VIBRATING FEEDER



"WAYTROL" WEIGHBELT



Jeffrey-Traylor "WAYTROL" feeds and weighs continuously

The Jeffrey-Traylor WAYTROL Constant Weight Feeder provides guaranteed accuracy within plus or minus 1% when belt speed is constant.

In the above installation a Jeffrey-Traylor Electric Vibrating Feeder delivers the material from the supply hopper. Its rate of discharge is controlled by an instantaneous, positive electrical system. It feeds to the Weighbelt which operates like a highly sensitive laboratory balance at constant or variable belt speeds.

If fine, fluffy materials are handled, a Jeffrey-Traylor Rotary Bin Check Valve is installed on the bottom of the supply hopper to assure continuous supply to the electric vibrating feeder.

The inherent accuracy of WAYTROLS is now serving many industries which handle scores of different products in their weighing and proportioning systems. Write for full information.

OTHER JEFFREY-TRAYLOR EQUIPMENT:

FEEDERS • DRYERS • PACKERS • COOLERS • CONVEYORS • SCREENS • CONTROLS • BATCHERS

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IF IT'S MINED, PROCESSED OR MOVED
...IT'S A JOB FOR JEFFREY!

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Once upon a time a Milwaukee spice processor got fed up with replacing \$18.00 screens ruined by tramp iron hurled through them by a spice mill.

So he called his Dings Magnets representative, who advised him to put a Dings Perma-Plate Magnet at the base of the hopper that fed the mill.

This powerful, non-electric Alnico magnet traps and holds tramp iron in its field until the mill is cleaned at the end of an operating cycle.

This is the way Dings Magnets can help processors of all kinds to protect equipment, produce a more pure product. Write for free Catalog C-5000-B.

Dings

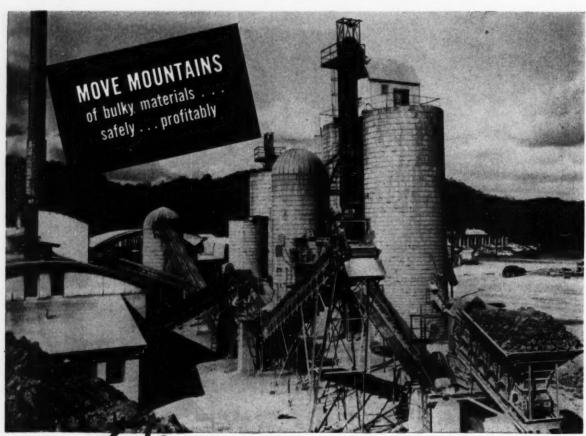


DINGS MAGNETIC SEPARATOR CO. 4730 W. Electric Ave. • Milwaukee 46, Wisconsin



it's a powerful, non-electric Dings Perma-Plate. Perma-Plates are available in a complete range of sizes and three strengths. They're easily installed in chutes, ducts, ever belts and elsewhere. They require no maintenance, have certified strength that's guaranteed forever.

Magnetic Separation Leader for over Fifty Years



inside a Marietta concrete storage system

Meet increasing demands for safe, easily accessible storage for bulk materials now and be prepared for the future . . . with Marietta Concrete Storage Silos.

Your Marietta System will be engineered to perform every storage and materials-handling task your plant requires, with any type of intake or discharge or mechanical handling system that will expedite your operations. Any feature desirable can be provided . . . shakers, screens, live storage shelves . . . and the extra factor of

strength built into Marietta Concrete Storage Silos makes it possible to mount heavy equipment on top or sides whenever needed.

This flexibility of design, incorporated in every Marietta Storage System, easily provides for increased handling capacity for future expansion, in addition to allowing you to enjoy lower operating costs today. Write Marietta for your catalog which shows how modern Marietta Storage Systems can cut your handling costs.



MARIETTA AIR-CELL lightweight aggregate STAVES

Stronger...thicker than standard staves... on exclusive Marietta development. Give greater protection especially when dry materials are stored.

Marietta precast Air-Cell staves, made from lightweight aggregate, are 3%" thick and provide insulation value equal to 15" of solid concrete.



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AMPCO* METAL

... the special alloys that make good where other metals fail

HERE are some of the properties of Ampco Metal that help you keep production up, costs down:

- Excellent resistance to corrosion in certain media.
- High tensile and compressive strength.
- Unusual resistance to wear from abrasion, erosion, and cavitation pitting.
- High physicals at extreme temperatures.
- High rate of heat transfer.
- High impact and fatigue values.

Because it combines all of these qualities, Ampco Metal is often called The Metal Without an Equal.

No matter what you do — whether you work in the chemical or process industries, refine oil, run a steel mill, make stampings, generate power, or any of hundreds of other jobs, you can make Ampco Metal work for you. It saves operating headaches and production grief, because it often makes good where other metals fail.

These versatile special alloys fight wear, corrosion, impact, fatigue; give long life and dependable performance under the severest conditions. That's why they are widely used in such tough assignments as fractionating towers, exchanger components, slippers and screw-down nuts for blooming mill service, aircraft parts, dies, valves, bushings, and other punishing jobs.

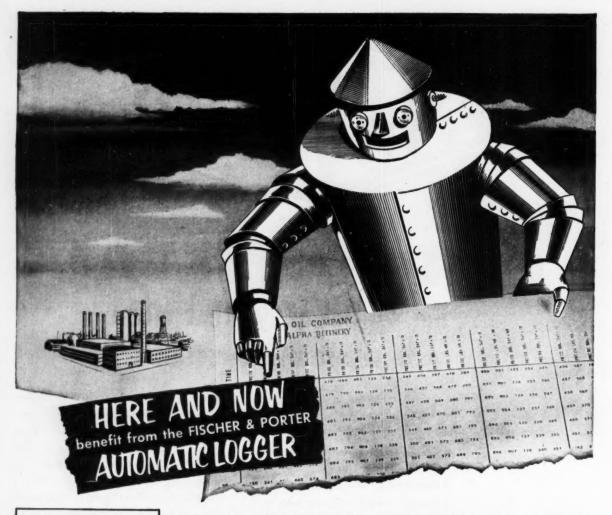
Chances are Ampco Metal can help you, too. It's available in sand and centrifugal castings, sheets, plates, bars, tubes, extrusions, welding wire and electrodes. Consult your nearby Ampco field engineer or write us for full information.

*Reg. U. S. Pat. Off.



Dept. CE-12 • Milwaukee 46, Wisconsin West Coast Plant, Burbank, California





CHECK THESE ADVANTAGES

- translates pneumatic and electrical signals into digital form for automatic controlling, computing and accounting.
- reduces instrumentation investment—saves space.
- increases efficiency with quick, accurate reporting.
- continuous scanning monitors operating conditions, announces and records off-norm actions at any time.
- relieves personnel now needed for manual logging, relating and interpreting operating information.

You now have immediately available a packaged data reduction system with great versatility for present application or later re-application . . . ready to integrate into your plant the latest means for computing, controlling and accounting.

The F&P Automatic Logger converts pneumatic and electrical signals into tabulated digital records specially designed for your needs. Logging occurs at preset intervals—but Logger continuously samples essential variables and stores information for interval recording. Thus, flow may be integrated continuously and logged as accumulated flow or average flow rate. The F&P Logger

employs analog computer techniques to reduce data to suitable form before digital presentation.

The F&P Automatic Logger tabulates useful data on automatically typed log sheet and simultaneously stores it on punched tape or in other digital form for automatic controlling, computing or cost accounting without the expenditure of a single man hour.

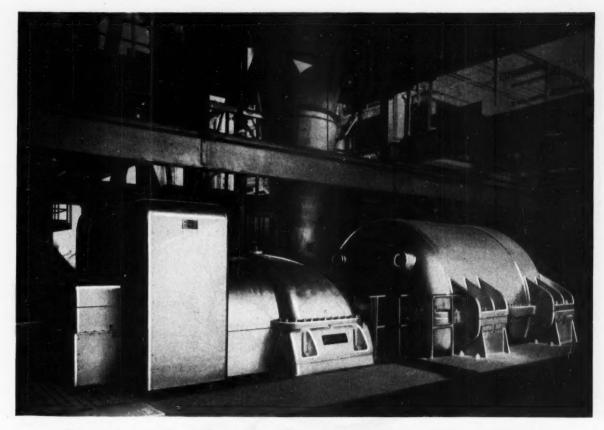
The F&P Automatic Logger is available now-ready to implement your new automation plans, ready to lower operating costs. Write for complete information or actual demonstration.

complete process instrumentation

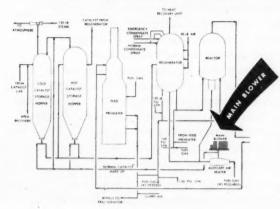
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MEASURING, RECORDING AND CONTROLLING INSTRUMENTS . CONTROL PANELS . DATA REDUCTION SYSTEMS CONTRACT INSTRUMENTATION RESEARCH . CHLORINATION EQUIPMENT . GLASS SPECIALTIES



Largest Centrifugal Compressor for fluid "CAT CRACKER" Service



has now been operating about a year in the Sinclair Refining Company's new refinery unit at Houston, Texas. The compressor handles 135,500 inlet cfm of air at 22.0 psig discharge pressure; the turbine develops 12,440 horsepower at 2400 rpm. Complete unit emphasizes ruggedness and accessibility, assuring reliable "non-stop" performance over long periods of time.

Large or small, Elliott can furnish your centrifugal compressor requirements and assure you of equally satisfactory performance. Elliott centrifugal air and gas compressors are serving the petroleum industry throughout the world. Consult your local Elliott office for details or write Elliott Company, Centrifugal Compressor Department, Jeannette, Pa.

Company























EJECTORS CONDENSERS

COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

CHEMICAL ENGINEERING—December 1954

305

Something that won't be there in your finished product



... can be the one thing needed to complete the picture

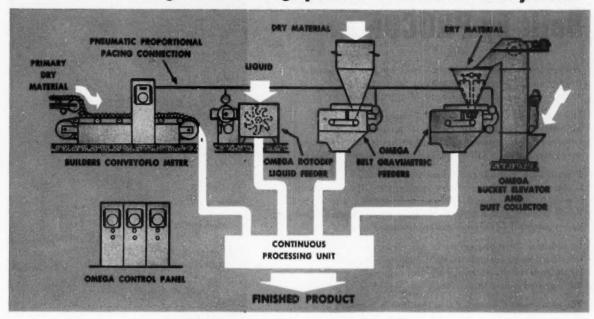
So often is diatomite filtration the vital step that page after page of this magazine would be needed to sketch briefly the processes and new developments in which it plays a key part. Without it, some of today's "wonder" products could not be available; others would not be economically practical. Diatomite filteraids, among which Dicalite products are outstanding for quality, give filtration so "sharp" that the finest micro-solids can be completely removed... yet with high rates of flow and high total throughput that make Dicalite filteraids economical in mass commercial applications. Being practically pure SiO₂, and sterilized in processing, Dicalite filteraids are chemically inert and cannot impart taste, color, or odor to the filtrate. All these desirable properties carry no premium price tag; the experience of thousands of users shows that Dicalite filtration is frequently more economical than less effective methods.

Technical bulletins on Dicalite filtration are available on request, and our technical service department and laboratories will be glad to help you in working out any special problems.

DICALITE DIVISION
GREAT LAKES CARBON CORPORATION
614 SOUTH FLOWER STREET
LOS ANGELES 17, CALIFORNIA



Another tough feeding problem solved by ...



OMEGA-CONTINUOUS-processing!



This Omega equipment package is the complete solution to a difficult feeding problem for a major food processing company. The Conveyoflo Meter weighs "non-flowable" materials — cohesive, fibrous fruits and vegetables — at high flow rates and with great accuracy. Pneumatic proportional pacing of Omega Dry and Liquid Feeders automatically keeps the flow of secondary materials in step with the primary flow . . . increases processing efficiency . . . insures uniform product quality under all conditions.

The extensive Omega line of Dry and Liquid Feeders is adaptable to all types of feeding and proportioning requirements. Omega equipment packages are complete in every detail; from control panel to auto-stop alarm devices, from hopper agitators to bucket elevators and dust collectors.

Send Compon

OMEGA MACHINE COMPANY



trol - wide feeding range - positive, non-flood roter available for "flood-able" materials-accurate within 1% over entire range specified.	(Division of B-I-F Industries, Inc.) 369M Harris Ave., Providence 1, R. I. Please send the following: Bulletin BiF-K7 describing this system Bulletin 35-G5Å — Omega Belt Gravimetric Feeder
	 Bulletin 65-H12 — Omega Rotodip Feeders Bulletin 550-H4A — Builders Conveyoflo Meter
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	City

Another Modern Refinery Built by PROCON

A completely modern refinery—built by Procon—is now producing high-quality petroleum products for Ingram Oil and Refining Co. at Meraux, La.

Here is another example of how Procon is serving the petroleum refining industry with its planned process construction . . . process construction that is planned so that every requirement will be successfully and economically fulfilled.

Procon's job at the Ingram plant was to install modern refining units, along with the necessary auxiliary facilities. The project was started by dismantling existing equipment. Then a 10,000 B/SD crude topping unit, a 4,000 B/SD UOP Fluid Catalytic Cracker, gas concentration, polymerization, and vacuum units were installed.

In addition to the process units, a considerable amount of offsite construction was completed by Procon, including buildings, steam generation, water supply and disposal systems, loading racks, and dock lines.

The same careful planning that resulted in Ingram's new and modern refinery is available to everyone when they choose Procon. And no matter what the scope of the project may be, construction by Procon means a job well-planned...and well-completed.



The polymerization plant is an integral part of the refining facilities built by Procon. Immediately adjacent to these columns will be found the gas concentration plant.

PROCON Incorporated

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AFFILIATED COMPANIES PROCON (CANADA) LIMITED
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The vacuum unit tower rises in the background. To the right of the lower can be seen the vacuum heater, and in the foreground, the "cat" cracker.



The UOP Fluid Catalytic Cracking unit as seen from a portion of the large tank farm at the new and modern refinery of Ingram Oil and Refining Co.

ON STREAM

ON TIME

ME

ON BUDGET

ON THE WABASH

By the banks of the Wabash River at Robinson, Illinois, this new 8,330 barrel-per-day Houdriformer of the Ohio Oil Company is on stream, producing a high yield of superior quality gasoline from naphtha charge stocks. The new catalytic reforming unit is equipped with three catalytic reactors, a guard reactor and a three-stage heater.

Engineered and constructed by the Catalytic Construction Company, it was completed on schedule. The actual cost was below the original estimate.

CATALYTIC ON-TIME ...

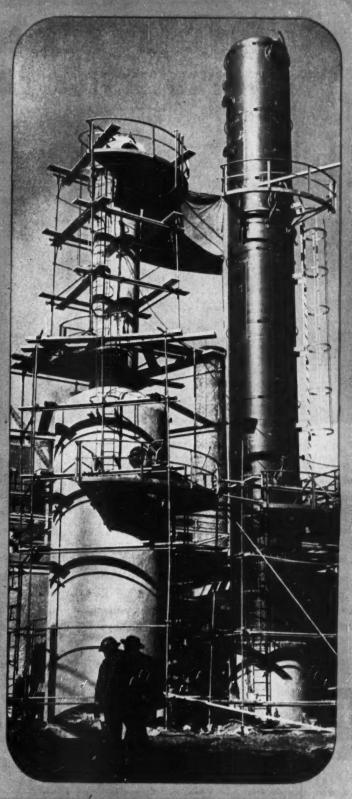
ON-BUDGET SERVICES

for the atomic energy, chemical, petrochemical and oil refining industries • Project Analysis • Process Design • Economic Studies • Engineering • Procurement • Construction • Plant Operation

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MANHATTAN RUBBER LININGS FOR PROTECTION THAT LASTS



You get long-life protection against metal corrosion and product contamination with Manhattan Rubber Linings. Manhattan craftsmen apply natural or synthetic rubber in thick, calendered sheets to produce a homogeneous rubber-to-metal bond that cannot be physically separated. Manhattan Rubber Lining on your tank expands and contracts with the metal under temperature changes without hardening or cracking. It presents a resilient, non-breakable surface that effectively resists abrasion, knocks of ordinary usage. And to doubly assure satisfactory results, your

Manhattan Rubber Lined Equipment is tested dielectrically under 15,000 volts. • This Manhattan method of rubber lining means permanent protection from corrosion of costly steel tanks and equipment . . . positive protection against contamination of process fluids used in your operations. It's a method based on more than 60 years of experience in quality rubber engineering craftsmanship. Let a Manhattan lining engineer show you how to get life-time protection against corrosion with Manhattan Rubber Lined tanks, pipe, fittings, extractors, evaporators, etc., for the chemical industry.

RUBBER LINING PLANTS AT PASSAIC, N. J. AND NORTH CHARLESTON, S. C.



MANHATTAN RUBBER DIVISION-PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.















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elts Conveyor B

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Other R/M products include: Industrial Rubber * Fan Belts * Radiator Hose * Brake Linings * Brake Blocks * Clutch Facings
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RM-423



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PULVERIZING MACHINERY DIVISION

METALS DISINTEGRATING COMPANY, INC.

55 CHATHAM ROAD SUMMIT, NEW JERSEY

MIKRO-ATOMIZER

for ultra-fine grinds

CHEMICAL ENGINEERING—December 1954

MIKRO-AIRACON for air-conveying





The chips that talk.

To the native savage, whose tribe had no conception of a written language, the piece of wood on which the explorer scribbled a message became the wonderful "chip that talks."

The chips of metal that pour in silver drifts from the mighty machines in Sun Ship's Wetherill plant tell their stories, too. Those shown on the 14-foot boring mill tell part of the story of a fast, thorough repair job on ship-propulsion machinery. That job required lifting a 54-ton section of crankshaft from the ship to a 10 ft. x 50 ft. engine lathe, where

ON THE DELAWARE

it was checked for trueness and the journals machined. The crankpins were machined in a huge crankshaft machine. The boring mill operation shown was the facing of the webs of a new section which replaced one of the damaged sections of the crankshaft.

That's the kind of story the versatile men and machines at Sun Ship have been writing for decades . . . in building special machinery of every type for the varied industries that are building a greater America.

CHESTER, PA.

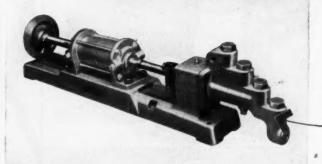


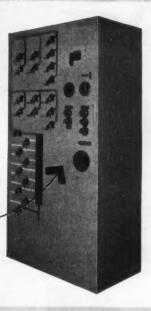
SINCE

25 BROADWAY . NEW YORK CITY

CONTROLLED
VOLUME PUMPS
ARE
FLOW-CONTROL
INSTRUMENTS

This Milton Roy graphic panel provides centralized control and monitoring of 23 airpowered Controlled Volume Pumps to regulate a continuous polymerisation process.





Typical "aiROYmetric" Controlled Volume Pump. Air-powered pumps have a capacity range of from .04 to 405 gallons per hour against pressures up to 25,000 pounds per square inch. Capacity can be varied manually or automatically.

MILTON ROY GRAPHIC PANEL CONTROLS CONTINUOUS PROCESS

Flow controllers, ratio controllers and final control elements... these are the functions performed by 23. Controlled Volume Pumps in automatically controlling a continuous process.

This graphic panel—installed after full study and pilot plant testing—provides centralized control and monitoring of all 23 Controlled Volume Pumps used in the process. Some of these pumps control the flows and maintain the ratios of process streams. Others are used as final control elements, controlling the flow of catalyst in response to process demand, as dictated by the reactor temperature controller.

Milton Roy Controlled Volume Pumps are flow-control instruments that can solve your flow-control problems. Our Engineering Services include detailed recommendations on pumps, process instrumentation, accessories, panel design and construction.

Reference Literature: Write for Application Engineering Data Sheet A-54-2 "Instrumentation of a Continuous Reactor" and Bulletin 1053 "Air-Powered Controlled Volume Pumps."



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CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS



BEST GIFT for YOUT PLANT DEPENDABLE "BUFFALO" FANS

DEPENDABLE "BUFFALO with the FAMOUS "Q" Factor*



TYPE "BL" FANS

In sizes for 1,000 to 500,000 cfm, these new non-overloading fans for general ventilation and air conditioning offer even finer performance than their famous predecessors, the "LL" Fans.

NEW BULLETIN F-100



New! NV-BREEZO FANS
Their specially-shaped four-blade
wheel gives high efficiency even
against system pressures of ¼" and
½". 8" to 24" sizes.
BULLETIN 5865



DRAFT FANS
"Buffalo" mechanical Draft Fans are helping turn out low-cost steam in plants and major utility stations everywhere.
BULLETIN 3750



BELTED VENT SETS
Non-overloading ventilating fans for duct or free air delivery. Extra quiet.
BULLETIN 3720



New! BELT-AIR FANS Quiet, sturdy fans to move a lot of air at negligible cost. Heavygauge die-stamped blades and panel. WRITE FOR DETAILS



INDUSTRIAL EXHAUSTERS All-welded for strength and high efficiency. With air or material wheels. BULLETIN 3576



"CB" PRESSURE BLOWERS Up to 2½ psi, single stage with these husky, space-saving units! BULLETIN 3553



SHORTBOY VENTILATING SETS Quiet, efficient, vibration-free fans. Wheels mounted on hollow shaft. BULLETIN 3701



AXIAL FLOW FANS Compact, light, highly efficient ventilating fans for light duty. BULLETIN 3533



EXHAUSTERS
For low to medium pressures and volumes in draft, cleaning, line boosting.

BULLETIN 3014



VOLUME FANS
Rugged blowersexhausters with cast
iron housings and dustproof ball bearings for
any job up to 10" s.p.
BULLETIN 3615

Buffalo

*The "Q" Factor — The built-in Quality which provides troublefree satisfaction and long life.

BUFFALO FORGE COMPANY

501 BROADWAY

BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

FORCED DRAFT, PRESSURE BLOWING, HEATING, COOLING, VENTILATING, AIR CLEANING, AIR TEMPERING, INDUCED DRAFT, EXHAUSTING

A "cushioned" porcelain-to-porcelain seal in the Lapp Valve

The chemical resistance qualities of the Lapp Valve come from the fact that the body and plug are both solid porcelain. Porcelain, as a material, however, has little resiliency or "give" when the plug hits the seat in the body. Special spring-loaded "cushion" seating in Lapp valves prevents damage from a heavy-handed operator, and warns when seal is tight. Built into the thrust bushing of every Lapp Y-valve and angle valve, is an arrangement of tempered Beryllium copper spring washers. This spring loading also provides that a closed valve will maintain its tightness even under vibration and thermal movement of parts.



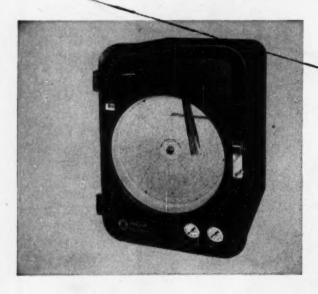
HAGAN

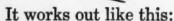
Ring Balance Meter

beats the high cost

of Permanent

Pressure Loss!





Using an Expensive Primary Element . . . 10% of 100'' full scale differential is 10'' PPL

Using a Low Cost Primary Element . . . 50% of 6" full scale differential is only 3" PPL

The Hagan Ring Balance Meter is particularly adapted for accurate operation at full scale differentials as low as 1" WC, with any type of primary element. In many applications, by choosing a low cost, low differential element, with a PPL of 50% or more, and measuring the flow with a Ring Balance Meter, the actual permanent pressure loss is low. In the example shown above, it is only a third of the actual PPL sustained with a high cost, high differential primary element. Here is positive, long range economy ... lower pumping costs result from reduced horsepower requirement.

This is an example of how Hagan experience and engineering skill can reduce costs. Hagan engineers will be glad to recommend the most economical solution to your metering problem.



HAGAN CORPORATION

HAGAN BUILDING
PITTSBURGH 30, PENNSYLVANIA
Boiler Combustion Control Systems, Ring Balance Flow and Pressure Instruments . . . Metallurgical Furnace Control Systems . . .
Control Systems for Automotive and Aeronautical Testing Facilities

Do these 5 NEW AZZA SOLENOID VALVES

meet a special need for you?

Five completely new solenoid valves were developed by ASCO during 1954. Smaller size, greater efficiency and longer reliable life fit these valves to specific industrial uses.

A NEW ASCO 2-WAY SOLENOID VALVE

COMPACT: Only 234" face to face; 313/16" overall

Simple: Just two operating parts. Can be mounted in any position. Low power

> consumption. Standard, explosion proof or watertight solenoid enclosures. Normally open or normally closed.

BULLETIN 8210A

A NEW ASCO 4-WAY MIDGET SOLENOID VALVE

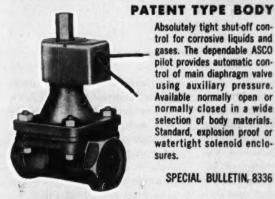
Designed for control of small double acting cylinders. Compact: Under 4½" high, 2" wide, 2" deep with standard NEMA I sol-

enoid enclosure. Operates up to 400 cycles per minute mounted in any position. Standard, explosion proof or watertight solenoid enclosures.

BULLETIN 8345



A NEW ASCO SOLENOID PILOT CONTROL VALVE WITH SAUNDERS



Absolutely tight shut-off control for corrosive liquids and gases. The dependable ASCO pilot provides automatic control of main diaphragm valve using auxiliary pressure. Available normally open or normally closed in a wide selection of body materials. Standard, explosion proof or watertight solenoid enclo-

SPECIAL BULLETIN, 8336



A NEW ASCO CORROS-ION RESISTANT, CYLINDER OPERATED 2-WAY VALVE

BULLETIN 8338

Two valves designed specifically for processing plants where corroding

liquids or gases are handled. Many types of body materials available. Standard, explosion proof or water-tight solenoid



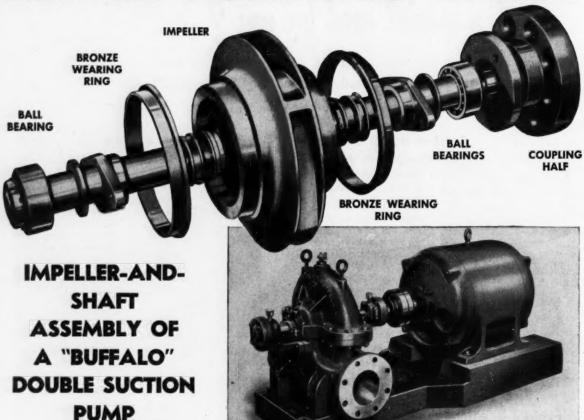
A NEW ASCO CORROSION RESISTANT 3-WAY SOLENOID VALYE SPECIAL BULLETIN 8300



Write for additional details on any of these valves. Please specify bulletin number.

WE DESIGN AND MANUFACTURE A COMPLETE LINE OF SOLENOID VALVES AND ELECTROMAGNETIC CONTROLS INCLUDING AUTOMATIC TRANSFER SWITCHES, REMOTE CONTROL SWITCHES, CONTACTORS, RELAYS, AND COMPLETE CONTROL PANELS.

INSIDE STORY OF A BETTER PUMPING VALUE



"Buffalo" Double Suction Pump

Take a look at the "heart" of a clear water pump that is built for performance and endurance! Note the oversize shaft and ample ball bearings to stand the severest continuous - service strains. The double suction enclosed impeller is hydraulically balanced and has vanes and shrouds shaped for maximum efficiency. The two large bronze wearing rings on either side of the impeller prevent leakage, thus keeping effi-

And in the pump casing, water passages are simply formed with ample area to avoid friction losses and sudden changes of velocity. (Top half of casing is easily removable without disturbing piping, for quick servicing of impeller and stuffing boxes).

Here is a pump that cuts your

costs where economy really counts
— in continued high efficiency,
in freedom from breakdowns, in
easy maintenance and the kind
of lifetime performance you need
on your pumping job. Write for
Bulletin 955-P and check construction data on these pumps in
sizes from 10 to 14,000 gpm.



BUFFALO PUMPS, INC.

501 BROADWAY

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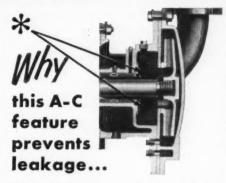


A-C Pump runs 4 times longer than previous unit ... and still going strong

A LARGE EASTERN CHEMICAL COMPANY is using Allis-Chalmers 4 x 3 PDE process pumps with Equiseal stuffing boxes to handle phosphoric acid water containing abrasives. These pumps operate 24 hours a day, 7 days a week. The unit shown above has been in use for approximately two years and has never been shut down for maintenance. The pumps previously used had to be completely reworked every six months and re-packed every three weeks. Naturally, maintenance costs have been drastically reduced.

Allis-Chalmers process pumps are available with or without *Equiseal* stuffing box, in a wide choice of materials to handle many types of abrasive or corrosive material at temperatures to 250° F. Every pump is individually engineered to each application. For details, contact your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 52B6615.

Equiseal is an Allis-Chalmers trademark.



Many A-C process pumps have the Equiseal stuffing box. This is an auxiliary impeller which produces a low pressure area in front of the packing. This low pressure area prevents the liquid being pumped from entering the packing (on suction heads to 15 feet at 1,750 rpm). Equipped with an Equiseal stuffing box, an A-C pump will actually run without packing.

ALLIS-CHALMERS

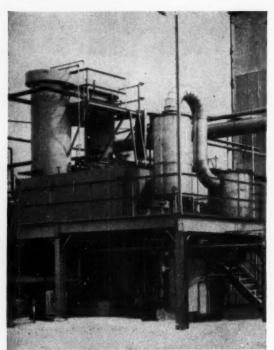




NEW PLANT MAKES

Phosphoric Acid And Polyphosphates

More details on pp. 132-134.



NOVEL COMBUSTION CHAMBER for phosphorus—a highlight of the phosphoric acid unit.

New, with novel innovations, that's Virginia-Carolina Chemical Corp.'s phosphoric acid-sodium polyphosphate plant now on stream at Fernald, Ohio.

At first glance the flowsheet of the process looks like a "standard design." And superficially this is true. It involves three well known steps: (1) combustion of elemental phosphorus to phosphoric anhydride (P₂O₃), (2) hydration of the anhydride to phosphoric acid and (3) reaction of the acid with soda ash, and calcination to sodium tripolyphosphate (Na₂P₂O₁₉).

But incorporated into the plant are important and new features. Among them: novel design for combustion chamber and hydrator—a big step away from conventional graphite and carbon construction; a continuous unit handles a phosphate solution.

▶ Big Tripoly Demand—Some of the plant production (36,000 tons per yr. of phosphoric acid) is purified to food grade acid. But most is converted to sodium tripolyphosphate. Tetrasodium pyrophosphate (Na₄P₂O₂) is also produced.

Tripoly is an important detergent builder. It acts as a dispersing and sequestering agent. Rapidly taking over in this field, some 468,834 tons were produced by all U. S. manufactures in 1953. In 1952, this was 370,790 tons.

The Process at Fernald—Tank cars of elemental phosphorus come from V-C's Nichols, Fla., or Charleston, S. C., electric furnaces. It's transferred, by water displacement, to steel storage and feed tanks.

A critical step in the process involves combustion of phosphorus. This is carried out in a combustion chamber operating under pressure.

Phosphorus flows to a "burning" nozzle in the chamber, the rate being regulated by displacement water metered through an orifice. Metered steam (for atomization of phosphorus) and compressed air mix with the molten phosphorus in and around the nozzle.

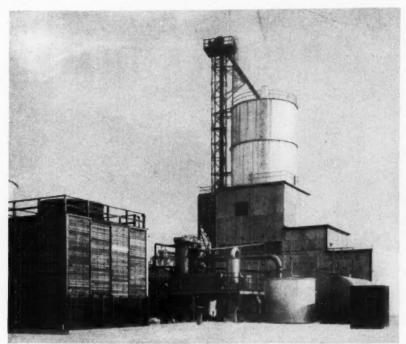
Flame temperature at the nozzle is around 3,600 F. ► Hydration to the Acid—After combustion, P₂O₆ passes through an air cooled duct and enters the packed (Raschig rings) stainless hydrator. Here weak (30%) acid is injected through spray nozzles, hydrating the P₂O₆ to a 75-85% phosphoric acid. This strong "technical grade" acid flows through a heat exchanger into a 8,300 gal. tank.

Gases exiting from the hydrator are scrubbed with weak (30%) phosphoric acid, the liquid separated in a cyclone scrubber and glass wool filter. This liquidactually weak phosphoric—is adjusted to 30% with demineralized water, and recycled.

Food grade acid is made by treating 85% H_sPO_s with H_sS to remove arsenic.

► How to Make Tripolyphosphate—Most of the strong tech. acid is adjusted to a 75% conc. and pumped to a mix tank. Here soda ash, steam and water are added forming a solution of mono- and disodium phosphate. Carbon dioxide comes off, and is scrubbed by the incoming water. After checking pH and density (for tripoly there must be a 1.67 ratio of Na₂O/P₂O₆) the solution is filtered and sent to the continuous unit. Here drying, molecular dehydration, conversion to polyphosphate, annealing and cooling take place successively along the length of the unit.

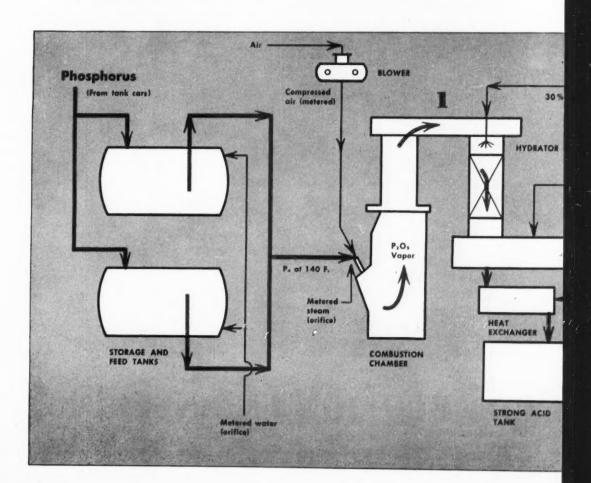
Grinding, storage and packing complete the process.

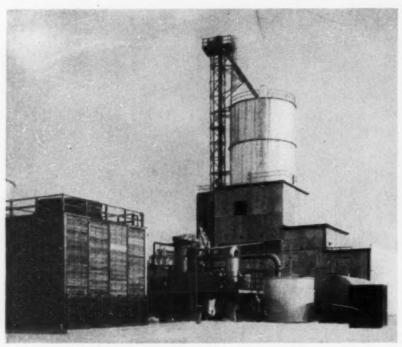


2 SODIUM POLYPHOSPHATE BUILDING, showing the soda ash hopper with loading equipment. Soda ash feeds into the mixing and reaction tank.

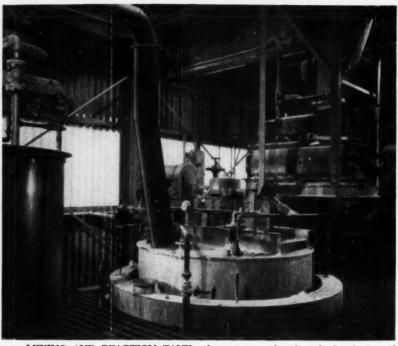


3 MIXING AND RI combine to form soc

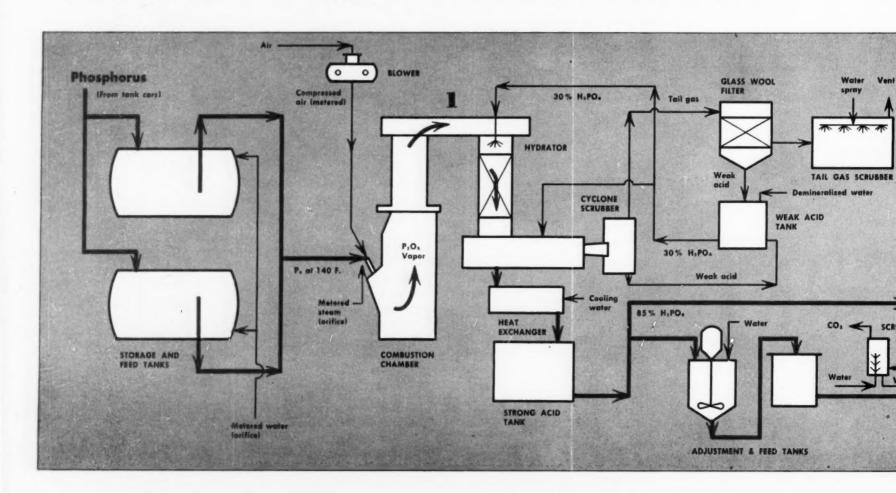


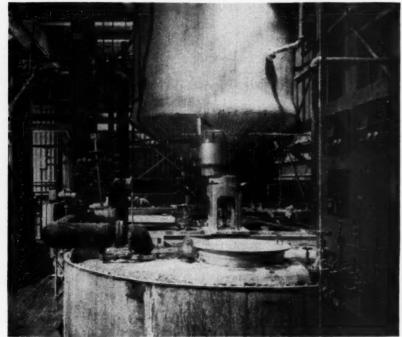


2 SODIUM POLYPHOSPHATE BUILDING, showing the soda ash hopper with loading equipment. Soda ash feeds into the mixing and reaction tank.

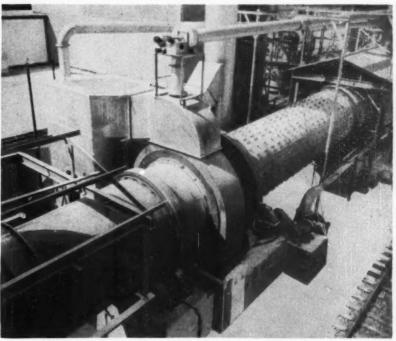


3 MIXING AND REACTION TANK, where steam, soda ash and phosphoric acid combine to form sodium phosphates. Carbon dioxide is also formed.

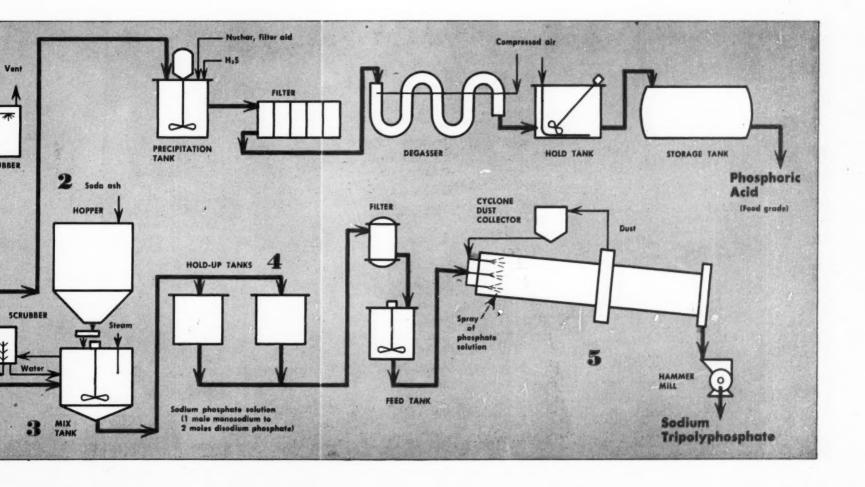




4 HOLD-UP AND ADJUSTMENT TANKS. Here the sodium phosphate solution is sampled for control tests such as density and pH.



5 CONTINUOUS UNIT takes a phosphate spray. Drying, molecular dehydration, conversion, annealing and cooling all take place in the unit.





Acetate Solvents, Crude Acetate Solvents, Pure Acetic Acid Acetic Anhydride Acetone Acetylene, 15 psi Air Alcohols Aluminum Cl Aluminum F Aluminun Alumin Alums Ammonia Gas Cresylic Acid **Ammonia Liquors** Ammonium Bisulfite (above 7.0 pH Ammonium Carbonate Ammonium Chloride Ammonium Hydroxide **Barium Cyanide Barium Hydroxide**

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Solutions

Hydrogen Gas Hydrogen Peroxide Hydrogen Sulfide Iron Chloride (Ferric) Iron Chloride (Ferrous) Iron Potassium Sulfate (Ferric Alum) Iron Sulfate (Ferric) (Ferrous

Sulfuric Acid Sulfurous Acid Tartaric Acid Tin Chloride (Stannic) Tin Chloride (Stannous) Sulfate (Stannic) Sulfate (Stannous)

Magnesiu fate ulfite Magnesia Mercuric Chloride Oxal Acid xy hard

etroleum Oils, Refined

Phenol (Carbolic Acid)

Phosphoric Acid Acid, Aqueou

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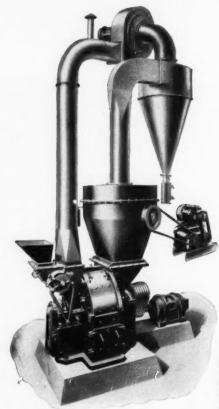
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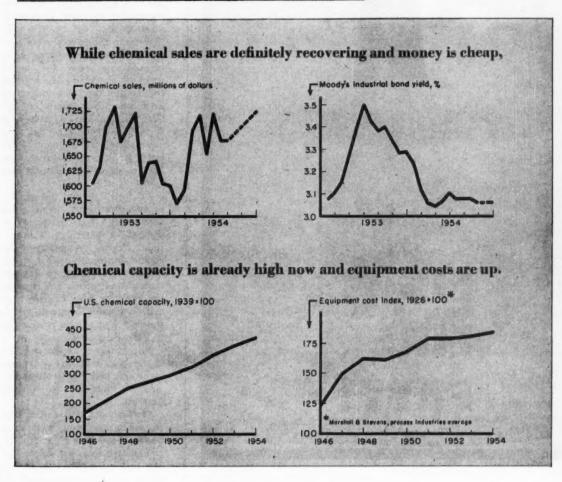
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Should You Plan to Expand in 1955?

Obviously there's no pat answer to this vital question. But to plot your own course, it's essential that you weigh all these basic—yet dynamic—factors.

William H. Chartener, McGraw-Hill Dept. of Economics

Is the economic climate attractive for expansion? On the pro side, chemical sales have recovered from the drop in late 1953 and business conditions generally look better. But the enormous capacity increases already made in most of the chemical process industries have many companies wondering

about the advisability of more building now.

This isn't because of any doubts on the long range prospects for the chemical industry. Probably just about every bit of capacity now being added or contemplated will be needed—eventually.

But is the year 1955 the time

to go ahead with further expansion? Or should you hold off until you see what happens to chemical markets, to business in general, to construction costs and the money market?

These Factors Look Good

First, let's look at some of the inducements you have to build new capacity in 1955, apart from prospects for a general rise in industrial production and increased demand for chemicals.

▶ Possible Bargain-You may be



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ECONOMICS . . .

able to find surprisingly good terms —by recent standards, at least—in construction.

Building contractors' costs have continued to rise because of increased wage rates and higher prices for materials. The building and construction cost indexes of Engineering News-Record, a McGraw-Hill publication, have risen 4-5% in the past year. But these indexes don't reflect improved efficiency or shifts in materials. Contractors' prices have actually been falling in many areas.

The reason is that the capacity of the construction industry has risen beyond even today's record demand for its services. Competition is forcing contractors to become more efficient and is squeezing their profit margins. The industrial construction field, hurt by the 8% drop from 1953 in plant and equipment expenditures, is showing signs of this competition in lower bid prices.

Improvements in the engineering of both buildings and equipment also have been cutting construction costs for the chemical industry.

Only two years ago, an ammoniafrom-natural-gas-plant with a capacity of 100 tons a day probably would have cost over \$5 million. For that price today, you might, under favorable circumstances, be able to build a 300-ton plant. And a new 100-ton plant can now be built for just a little over \$3 million, according to the Chemical Process Division of the M. W. Kellogg Co. ► Cheap Money—An adequate supply of money for industrial construction is another inviting reason for building in 1955. capital is available on about the most attractive terms since the late

Moody's industrial bond yield average has been holding close to the 1953-54 low of 3.04%, compared with the 1953 top of 3.51%. And Aaa grade bonds have been running near the 1954 low of 2.76%, as against the 1953 peak of 3.41%. These percentage differences may seem small, but the saving on long-term financing can be huge.

Internal capital naturally varies widely from company to company. Whether money is actually available for new construction may depend largely on how well profits have been bearing up this year. On many balance sheets, however, depreciation allowances on postwar expansion programs and amortization from five-year emergency fast tax write-offs bulk large. This money can now be used to finance further expansion.

The new depreciation provisions authorized in the 1954 tax law (see also pp. 171-174) afford still a further incentive to make new capital investments now.

Under the new "double declining balance" formula, you can now deduct twice as much for tax purposes in the first year and can depreciate roughly two-thirds of the total cost in the first half of the estimated useful life. This represents a postponement—and perhaps a net saving—of taxes and permits recovery of most of the investment much earlier than under the traditional "straight-line" depreciation method.

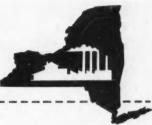
For chemical companies accustomed to five-year amortization certificates on emergency defense facilities, the double declining balance system may not look like any great bargain. But few new certificates are now being granted, so comparison of these two methods of fast depreciation is now largely academic.

There Are Drawbacks

Now, what about the reasons for caution on expanding in 1955. ► Too Many Plants—The chemical industry may be running into a period of temporary over-capacity.

The April 1954 Survey of Business Plans for New Plants and Equipment* indicated that expansion programs already completed or planned would boost the capacity of the chemical industry to three times the 1946 levels by 1957. Under the expansion program for defense facilities, certificates covering nearly \$3 billion

plant-location news



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Ronald B. Paterson

Director, Industrial Location Service

^{*}Made by the McGraw-Hill Dept. of Economics.



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ECONOMICS . . .

for chemicals and allied products have been issued since 1950; about 80% of these new facilities are already in place.

For the individual company, though, over-capacity is a matter of specific products and particular periods of time. In considering a new ammonia plant, for instance, management must ask itself these questions: Should we build a plant now at the risk of industry over-production and a possible price break in the next year or two? Or should we postpone building plans at the risk of having inadequate capacity to meet the rising demand that is certainly coming?

► Variable Construction Costs— This is another area where management must weigh the relative risks of building now or waiting.

In light of continued high demand for highway, commercial and school construction and for housing, it appears unlikely that construction prices will move down significantly in the near future. High wage costs put an element of rigidity into construction costs. But increasing competition among contractors could force down their margins further.

Changing Technology—Related to both questions—possible over-capacity and construction savings—is the problem of rapid obsolescence in chemical processing. If increased capacity isn't needed immediately, you may find yourself stuck with an expensive, outmoded plant by the time market opportunities develop. Competitors with newer facilities then may have lower capital costs from more efficient construction and lower operating costs from better design.

The trend toward more efficient capital equipment in the chemical industry is indeed striking. Some figures introduced by R. W. McNamee and L. E. Erlandson of Union Carbide and Carbon Corp. at the September ACS meeting in New York show just how strong this trend has been.

Financial data for selected chemical companies indicate that, whereas it took \$1.69 of investment to produce \$1 worth of chemicals (net sales) in 1939, it took only

90¢ in investment to produce \$1 worth in 1953.

These are just some of the immediate considerations management will have to weigh before deciding on plans for expansion in 1955. For a more detailed discussion of the way your financial officers will look at expansion programs, see Chemical Engineering, April 1954, p. 347.

Good Growth in Mexican Chemicals, More Needed

Indicative of Mexico's strong desire to become an industrial rather than strictly agricultural nation is the fact that its finance agency, Nacional Financeria, increased credits to chemical firms from about \$600,000 in 1952 to more than \$2.6 million last year. Sulfuric acid, caustic, sodium sulfate, hydrogen peroxide, fertilizers and coal derivatives were the biggest expanders.

But it's just a beginning. In fertilizers alone, the agency says, Mexico is still short of 156,000 tons a year and needs to double its production. (Production in the year ending June 30, 1953, was 135,000 metric tons.) Potentially, the 5 million acres of improverished Mexican land could easily use a million tons of fertilizers annually.

The sulfur picture is a little brighter. A study by the Mexican National Confederation of Chambers of Commerce predicts Mexico will eventually produce a million tons of sulfur a year. Production from the Tehuantepec Isthmus, by the Frasch process, is now running at the rate of about 200,000 tons annually. But a new development there by the Pan American Sulphur Co. may soon be turning out 500,000 tons a year by itself.

Tide Water Offers Unique Stock Plan

Knowing that its current expansion program makes it unlikely that any significant cash dividends can be paid in the near future,



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ECONOMICS . . .

Tide Water Associated Oil Co., New York, has come up with a new stock plan that's calculated to satisfy all stockholders-those who want dividends now and those who are most interested in capital

Here's what's being done: Stockholders are to be offered the choice of holding on to their present common stock or exchanging all or part of it for a new \$1.20 cumulative preferred stock that will pay no less than they have previously received on their common stock.

Thus, rather than pay small cash dividends on all stock, Tide Water will pay a normal dividend only to those taking the preferred option. Other stockholders will forego cash now in the interest of an anticipated rise in the value of their stock to be derived through the company's expansion and modernization program.

The offering is to be made to common stockholders other than Mission Development Co., Mission Corp. and Pacific Western Oil Corp., which collectively own about 53% of the outstanding common. Stockholders' action on the proposal was set for Nov. 15.

Economic Briefs

Merger: Despite published reports, Western Electro-Chemical Co. has not been taken over by American Potash Co., although the latter recently acquired 42% of Wecco. To assure autonomy, most of Wecco's other stockholders (representing over 50% of the outstanding common stock) have entered into a voting trust agreement for the next 10 years.

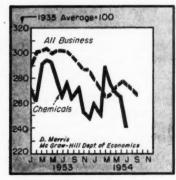
Stock split: Standard Oil Co. (Ind.) this month is paving a 100% stock dividend on its capital shares. Future policy of the company regarding cash dividends is still unknown.

Roadbinder: During the first three quarters of this year, use of sulfite pulping waste as a roadbinder in the state of Wisconsin has jumped more than 30% over

1953—to 57 million gal. Neighboring states, particularly Illinois, are also beginning to use substantial quantities, since some mills have made sulfite roadbinder available in concentrated form for economy of shipping.

Detergents: In the U. S., where synthetics comprise over 50% of the total detergent market, synthetics use in 1960 will rise to 1.5 million long tons, or 72% of the total market, predicts N. G. W. Luitsz of Shell Petroleum Co., London. Consumption in 1952 here was 0.8 million tons. In the Free World (excluding the U.S. and Canada), where synthetics hold less than 15% of the total market, he predicts a jump by 1960 to 1 million long tons, or 27% of the total, compared with 0.36 million in 1952.

CONSUMPTION INDEX . .



Business Activity (Sept.)...268.7 Chemical Consumption

	Aug. (Prelim.)	July (Rev.)					
Index	256.6	240.0					
Fertilizer	48.17	42.92					
Pulp & paper	32.53	28.33					
Petroleum ref	27.66	27.88					
Iron & steel	12.23	12.16					
Rayon	27.13	26.21					
Glass		24.16					
Paint & varnish	29.24	28.38					
Textiles	9.95	8.37					
Coal products	9.57	9.66					
Leather	3.98	4.14					
Explosives	8.71	7.97					
Rubber	4.52	4.48					
Plastics	17.52	15.38					



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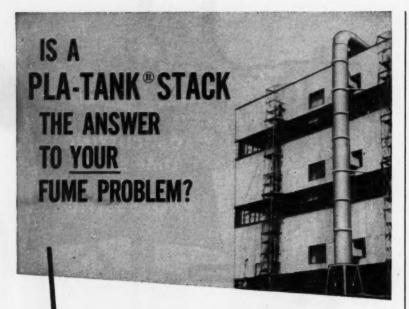
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The stack has a 44" diameter, is 69' long including 90° elbow, cross run to fan chamber and riser beyond fan. There are inlets from three floors to handle exhausts from individual tank systems. Stack was prefabricated with flanges for fast installation.

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THIS MONTH'S

Names in



T. Kenneth Haven

Vice president of the Detrex Corp., Detroit, Mich., Mr. Haven was former executive vice president of Reichhold Chemicals, Inc. In his new post, he will study proposed expansion programs in this country as well as foreign trade investigations and their ensuing operations.

Dan B. Wicker-Assistant director of research in charge of physical research for F. C. Huyck & Sons, Rensselaer, N. Y.

Calvin L. Dickinson—Director of engineering, American Potash & Chemical Corp., Trona, Calif. Harold Mazza has been appointed assistant director of research to direct activities of the New Products Division at the Trona research laboratory.

W. C. McCammon—Assistant to the president of Standard Oil Co. of Calif.

Wallace E. Pratt-1954 recipient of the American Petroleum Institute's "Gold Medal for Distinguished Achievement."

Frank Breyer—Director of Fluor Corp., Ltd., Los Angeles, Calif Mr. Breyer is a senior partner and co-founder of Singmaster & Breyer, Inc., New York, N. Y., whose stock is now controlled by Fluor Corp. R. K. Gitlin

- George M. Cleary-Chief engineer, Precision Thermometer & Instrument Co., Philadelphia, Pa.
- J. D. Wright—Production and development manager of Canadian Industries Ltd.'s plastics department, with headquarters in Montreal. Sidney T. Jones succeeds Mr. Wright as manager of the polyethylene plant in Edmonton.
- F. A. Henry-General manager of A. O. Smith's pacific coast works at Los Angeles, Calif.
- M. C. Sperry—Assistant director of Grasselli division, E. I. du Pont de Nemours & Co., Wilmington, Del. Thomas T. Chase succeeds Mr. Sperry as manager at the Grasselli plant, La Porte, Tex.
- Denton R. Wieland—One of 15 recipients in the U.S. of a fellowship from the Stanolind Foundation. Mr. Wieland is a graduate student at Texas A. & M., studying petroleum engineering.
- Hatton B. Rogers—Director of dry solubles division, Dodge & Olcott, Inc., formerly director of technical services for Huron Milling Co.
- Otto Vasak-Research engineer, California Spray-Chemical Corp.'s Richmond, Calif., plant.
- Fred Powell—Head of manufacturing department, Standard Oil Co. of Calif., succeeding O. N. Miller, now a vice president.
- Seymour M. Baret-Member of engineering department, Foster D. Snell Inc. formerly with chemical plants division, Blaw Knox Co.
- Harding Bliss-Editor of the new Journal of the American Institute of Chemical Engineers, to be published for the first time in



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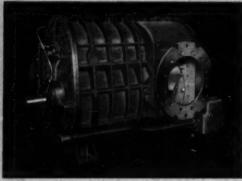
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NAMES . . .

January 1955. Dr. Bliss is professor of chemical engineering at Yale.

Thomas B. Leslie—Patent attorney for the Chemstrand Corp. Mr. Leslie was formerly engaged in patent activities for the Commercial Solvents Corp., Terre Haute, Ind., and the Gulf Oil Corp., Washington, D. C.



Douglas M. Considine

Mr. Considine has assumed the responsibilities of sales promotion and merchandising manager of P. R. Mallory & Co. Inc., after 14 years with Minneapolis-Honeywell Regulator Co. Starting as a member of the engineering staff of Honeywell's industrial division, he joined the market extension department during its early development, later became its manager. Mr. Considine is the author of Industrial Weighing and is editor of a forthcoming handbook on instrumentation engineering.

Robert E. Zinn-Partner in Vern E. Alden Co., Chicago, Ill., formerly professor of chemical engineering at Northwestern University.

J. V. N. Dorr-Honored by 100 members of his veteran staff. Dr. Dorr was presented with a scale model of the first Dorr classifier in celebration of the 50th anniversary of its inception.

Eric H. Reichl-Director of research and development, Pittsburgh Consolidation Coal Co.



Howard S. Turner

Dr. Turner, after six years' association with Pittsburgh Consolidation Coal Co., has been named vice president in charge of research and development of Jones & Laughlin Steel Corp. During World War II Dr. Turner was a member of the Industrial Technical Advisory Group on Research Problems in the quartermaster general's office.

J. J. O'Neill, Jr.—Appointed to the newly created position of assistant to the general manager, explosives division, Olin Mathieson Chemical Corp.

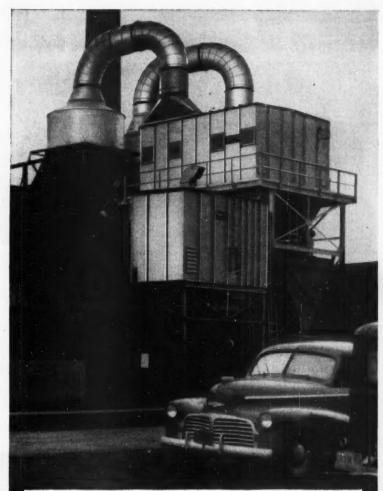
Robert G. Matters—Assistant director of research, Allis-Chalmers Manufacturing Co.

Lawrence E. Skelly—Engineering specialist with the Wheland Co., Chattanooga, Tenn. Mr. Skelly has long been active in the design of plants and equipment for the chemical and manufacturing industries.

R. Gordon Walker—Retired as vice president and general sales manager of Oliver United Filters Inc.

Howard W. Barlow-Director of Washington State Institute of Technology. Dr. Barlow was former dean of engineering at Texas A. & M. College.

Patrick J. Selak-Appointed to atomic energy division staff, Kaiser engineers division, Henry J. Kaiser Co. K. J. Caplan, formerly a consultant in dust



Pangborn shows Daystrom

HOW TO SOLVE A DUST PROBLEM

Back in the '30s, when Daystrom Co., Olean, N.Y., expanded into the production of tubular steel chairs and tables, dust became a major problem. Many of the new manufacturing processes created dust, jeopardizing employee health and community goodwill.

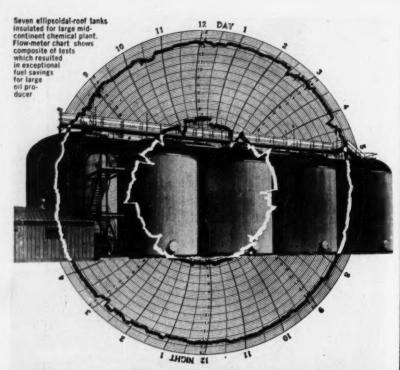
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says top executive recommending new tank insulation method

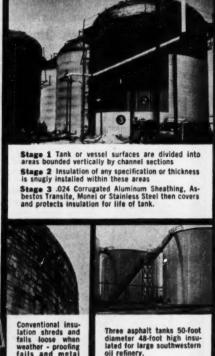
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We quote from a letter one big oil company wrote another about the Nicholson & Galloway 3-stage Tank Insulation Method:

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NAMES . . .

and fume control in St. Louis, is air pollution engineer in the division.

Kenneth C. D. Hickman—Consultant to the Consolidated Vacuum Corp., Rochester, N. Y.



Les Cunningham

L. A. Cunningham, well-known and well-liked Chicago representative of Chemical Engineering (Chem. & Met.) for almost 30 years, retired December 1 after 40 years of service with McGraw-Hill.

Andrew E. Buchanan, Jr.—General manager of the textile fiber department of Du Pont. Mr. Buchanan is a former assistant editor of Chem. & Met. and has also been associated with Du Pont's chemical department and the Remington Arms Co.

James C. Totman—Reelected to his third two-year term in the Maine legislature. Mr. Totman is assistant treasurer of Summers Fertilizer Co. and vice president of Northern Chemical Industries.

Max Key-Assistant production manager in charge of Dow Chemical Co.'s plastic production department's Midland operations. A. T. Maasberg has been advanced to the newly created position of technical director of the department.

William R. Funk-President of Durant International Corp., Williamstown, N. J. Walter H. Prine—Head of the electroplating-chemical-catalyst section of the nickel sales department, the International Nickel Co., Inc.

Arthur M. Brooks—Joined the market research and development department of Columbia-Southern Chemical Corp., after 24 years as vice president of Raffold Process Corp., Andover, Mass.

OBITUARIES

Henry Kreitzer Benson, professor emeritus of chemistry at the University of Washington, died September 27 at Seattle, Wash. Dr. Benson was on the faculty of the University of Washington from 1904 to 1947, heading the dept. of chemistry and chemical engineering from 1920 until his retirement.

Ralph H. McCormack, 47, professor of chemical engineering at the University of Detroit, died of a heart attack on Saturday, October 2. At the time of his death, Prof. McCormack was working on two classified research projects, one for the National Science Foundation, the other for the Department of Defense.

Ward Ely Pratt, 64, chemical consultant of the centrifugal pump division, Worthington Corp., died on October 5. Mr. Pratt was considered to be an expert on metal corrosion.

Alvah R. Small, retired vice chairman of Underwriters' Laboratories, died October 8 at his home in Pompano, Fla., at the age of 71.

Raymond Foss Bacon, 74, former director of the Mellon Institute for Industrial Research, died October 14 at his home in Bronxville, N. Y. Dr. Bacon, an internationally known chemical engineer, was recipient of the Distinguished Service Medal in World War I.





Q0 furfural,

an aldehyde, is an amber colored liquid; it is useful as a chemical intermediate in making open chain compounds, as a selective solvent in purifying mixtures such as lubricating oils and other petroleum fractions, as a resin forming agent in making molding powder and industrial resins, as well as a solvent, wetting agent, and pesticide.

QO (FA) furfuryl alcohol,

an amber liquid, is an excellent solvent for nitrocellulose, dyes and a number of synthetic and natural resins. Its largest use is based on its ready resinification when catalyzed by acidic reagents to form resins which are resistant to attack by acids, alkalies, and solvents.

QO (THFA) tetrahydrofurfuryl alcohol,

a water-white to pale yellow mobile liquid, is a high boiling primary alcohol. THFA is used as a chemical intermediate in making dihydropyran, agricultural chemicals, and plasticizers. It is also useful as a solvent and wettant.

Write for our Bulletin 201A, General Information about QO Chemicals

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THIS MONTH'S

Technical

Worthwhile Information

ORGANIC PROTECTIVE COATINGS. Edited by William Von Fischer and Edward G. Bobalek. Reinhold Publishing Corp., New York. 387 pages. \$7.50.

Reviewed by Kenneth Tator

In reviewing this book for chemical engineers, it is assumed that their interest will lie in one or a combination of three separate fields: (1) Application and use of protective coatings to improve appearance or prevent corrosion, (2) design, erection or maintenance of plants or operations manufacturing such coatings or coating materials, (3) formulation of new or improved protective coatings.

This book comprises a collection of papers, by authorities in their respective fields. It is thus not an inclusive or comprehensive reference on the whole subject of organic protective coatings.

It is written in such a style as to be of primary interest to paint chemists and formulators. It has little to offer in details of manufacturing equipment and operation to paint plant engineers. While most of its 16 chapters are of practical value only to the formulator, by judicious selection much worthwhile information can be gained by the user of protective coatings. A suggested scheme of reading for this purpose would include the six chapters covering paint as an engineering material, principles of formulation, anti-corrosive pigments, wood properties that affect paint performance, metal protection with synthetic resin coatings, hot-spray lacquers.

The chapter on hot-spray lacquers deserves special comment in that there is considerable and growing interest in these techniques for maintenance and production painting. While the subject matter of the chapter is pretty much confined to the use of nitrocellulose lacquers for product finishing, the L. B. Pope

principles and data presented are directly applicable to hot-spray applications for maintenance work and product finishings with other types of materials.

New Gmelin Volumes

Issued by the Gmelin Institute; E. H. Pietsch; Chief Editor. Verlag Chemie, Publishers; Weinheim, Germany. Available from Walter J. Johnson Inc., 125 E. 23rd Street and Stechert-Hafner Inc., 31 E. 10th Street, New York 3, N. Y.

Reviewed by M. Wulfing-hoff

Selenium. (System No. 10, Part A, Section 3. XVII, 184 pages, 158 graphs. \$25.64.) The first part deals with selenium rectifiers, their electrical properties, means for achieving desired performance characteristics, production and applications, and theory, including the Schottky-Mott barrier thesis. In an analogous manner, the selenium photocell is treated in the second part. The literature is complete as of 1953.

Boron. (Supplement volume. System No. 13. VII, 253 pages, 28 graphs. \$34.80.) Review of work by Stock, Schlesinger, Wiberg and others in the borane field, including borazoles, borazens, borazanes. Boron carbon compounds comprise alkyl derivatives of the boranes, borazoles, borazens, borazanes, alkyl boron compounds, alkyl boric acids, boroxoles, boric acid esters, alkyl boron halides. The work of Goubeau and others on boron fluoride and derivatives is presented, as is information on fluoroboric acids, crystalline forms of elemental boron, boron oxide, metaboric acid, the structure of boron, boron carbide, borones and borides. The "occurence" chapter deals with the geochemistry of boron, its distribution and properties of boron in the soil and in

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FEATURES

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Bellows section. A selection of seal face

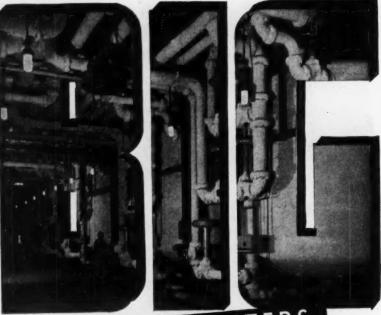
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BOOKSHELF . . .

plant organisms, starting from Goldschmidt's work in the 1930's. Genesis and structure of boron minerals is discussed, as are boron minerals, especially deposits in California, Turkeý, and the USSR. A comprehensive subject index concludes the volume.

Gold. (Parts 2 and 3. Part 2, V and 306 pages, 20 graphs. \$40.32. Part 3, XXI and 558 pages, 201 graphs. \$74.88.) Part 2 starts out with a chapter on occurence: Gold in planets and meteorites, geochemistry, biosphere, soils; the gold cycle, workable deposits. production statistics; gold minerals. A chapter on industrial production methods covers extraction by granulation, flotation, amalgamation, cyanide and chlorination methods, recovery from ores and industrial products. A chapter on special modifications discusses concentration and separation of isotopes, colloidal gold, and special applications. A chapter on the surface treatment of gold and its alloys completes the volume.

Part 3 covers the element, its physical properties, chemical, electrochemical and physiological behavior, indication and determination of the metal, general reactions of gold salts, and alloys, particularly Cu-Au and Cu-Ag-Au alloys, and mechanical properties. The theory of the order-disorder states, their effect upon the Au-Cu system, and literature data are fully discussed.

Happy Medium

PHYSICAL CHEMISTRY. By A. J. Rutgers. Interscience Publishers, New York. 804 pages. \$8.50.

Reviewed by F. C. Nachod

Some textbooks of physical chemistry are so condensed that they are limited almost entirely to a liberal arts curriculum. Some other texts on the other hand have grown so voluminous that they are more of a major reference book and certainly are cumbersome in didactic use. The present text, a translation of Professor Rutgers'

book which first was published in 1948 strikes a happy medium.

The subject matter is treated rigorously with a strong historical and chronological flavoring. Over and above what might be called classical physical chemistry there are chapters on "chemical physics" such as wave mechanics. A chapter on the atomic nucleus and an appendix and a physical chemistry of high polymer, the latter written by Turner Alfrey, Jr., concludes this very useful book. Undoubtedly it will be adopted by many a teacher of physical chemistry.

Extreme Brevity

CONDENSED PATENT PRAC-TICE. By Leonard M. Todd. Published by the author (New York). 12 pages. \$3.

Reviewed by Melvin Nord

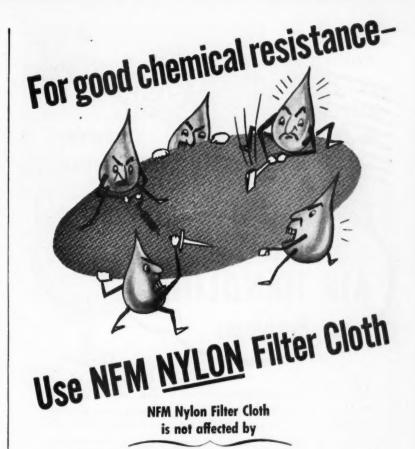
This little book covers, in extremely condensed outline and "flowsheet" form, materials which are helpful in preparing for the examination for registration to practice before the United States Patent Office. It will not be of interest to the general reader because of its extreme brevity and because it requires a working knowledge of patents in order to be intelligible. However, it is of value in its own field because of the unavailability of any similar condensation.

Survey and Summary

EXPERIMENTAL NUCLEAR Physics. Vol. II. Edited by E. Segré. John Wiley and Sons, New York. 600 pages. \$12.

Reviewed by A. L. Levy

This volume consists of two parts, one, a survey of nuclear reactions by Philip Morrison, and the second, a summary of the major developments in the physics of the neutron by Bernard T. Feld. In his introduction Feld says, "This work is primarily intended for the practicing nuclear physicist. It presup-



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ADDRESS

BOOKSHELF . .

poses a knowledge of the fundamentals of nuclear physics as well as of its terminology." This applies equally as well to the section by Morrison.

Morrison's survey is largely theoretical. It is concerned with analysis of data and critique of current theories, and is well done from these points of view. There is very little on the experimental methods of following nuclear reactions. The chapter on the nuclear model is of special interest and very well written. Other chapters include the data and course of nuclear reactions, nuclear fission, radioactive processes, and high energy reactions.

Feld's section on the neutron really is the experimental part of this book and covers all nuclear reactions involving the neutron. There is a wealth of data and instrumental methods in the chapters on neutron interactions with nuclei and with bulk matter, sources and detectors, and scattering phenomena. The chapter on the properties and fundamental interactions of the neutron is thorough and a fascinating history written so that others besides experimental nuclear physicists will find it interesting.

Lab Manual

Paper Chromatography. By Frederick Cramer. St. Martins Press, Inc., New York. 124 pages. \$5.

Reviewed by C. M. Martini

This book which is a translation of the second German edition, is actually a laboratory manual of paper chromatography. After a brief, clearly stated presentation of theory, there follows a detailed description of suggested experimental techniques. A description of the combined techniques of paper chromatography and electrophoresis is also included. The third and most extensive section of the book deals with the experimental results of actual separations, as well as tables of suggested solvent systems and indicators.

A rather extensive bibliography

is included which should prove to be a very helpful reference for those already acquainted with paper chromatography. For those using this method for the first time the manual should be an excellent introduction and a valuable assistant.

Companion and Sequel

COMPOUNDS WITH CON-DENSED THIOPHENE RINGS. By H. D. Hartough and S. L. Meisel. Interscience Publishers, New York. 532 pages. \$16.50.

Reviewed by A. H. Blatt

The nine chapters of this monograph, the companion and sequel to the earlier volume in the same series, "Thiophene and Its Deriva-tives" by Hartough, divides itself into the following five parts: (1) a brief discussion of reactivity and orientation; (2) a detailed discussion of the preparation and reactions of thianaphthene and dibenzothiophene, the two rings whose chemistry has been sufficiently systematically studied to permit such a discussion; (3) a discussion of some academic aspects of the chemistry of the thioindigo dyes; (4) a survey of the remaining condensed systems containing at least one thiophene ring and two to seven carbocylic fused rings or at least one thiophene ring and one additional heterocyclic ring; and (5) a survey of selenophenone and tellurophenone systems. The material covered in (4) and (5) is spread over so many ring systems with so little material on any one that these sections are inevitably of the nature of a catalog.

This monograph and its companion volume are essential to anyone who wants either a general orientation or specific information about thiophene and the more complex ring systems containing a thiophene ring. Only the chemist who wants a complete listing of the thioindigo dyes will have to go elsewhere. The monograph will serve not only as a source of information, but also as a stimulus to further work; and the authors have



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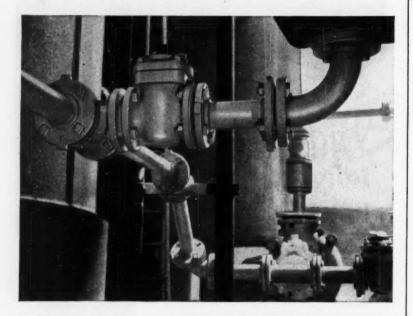
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HEAT EXCHANGERS
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SARAN LINED PIPE CHOSEN TO RESIST CORROSION

And it has meant trouble-free service for this Illinois manufacturer, conveying hydrochloric acid at temperatures from 20° to 90° F.



The durable, corrosion-resistant lining of these 2½" saran lined pipe, fittings and valves have paid off for an Illinois manufacturer by eliminating costly shutdowns due to corrosion. And they've brought

Saran Lined Pipe 2415 Burdette A	Company ve., Ferndale 20, Michigan
Please send me	a copy of your catalog on fittings and valves.
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Company	*
Address	
City	State
	SP-1162A-1

these additional advantages: 1. Easy Installation . . . saran lined pipe can be cut and threaded on the field using ordinary tools: no special equipment is needed! 2. Added Safety . . . the high-pressure strength of this steel-clad pipe eliminates danger caused by bursting pipe! 3. No Leakage . . . saran lined pipe, fittings and valves form snug, leak-proof joints!

If your operation requires the conveying of corrosive liquids, investigate saran lined pipe, fittings and valves. For further information contact The Saran Lined Pipe Company. THE DOW CHEMICAL COMPANY. Midland, Michigan.

RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

you can depend on DOW PLASTICS



BOOKSHELF . .

indicated many areas in which additional work is desirable.

One has only to compare the two volumes being reviewed with the original monograph of Victor Meyer on the same subject published in 1888 and with the Steinkopf monograph of 1941 to realize the developments in thiophene chemistry and the obligation which readers have to the authors, editor, and publishers for making this material available in one place.

Alumina & Aluminum

TONERDE UND ALUMINUM. By W. Fulda and H. Ginsberg. Part II, Aluminum. Walter de Gruyter, Publisher, Berlin. 360 pages. DM 44 or \$10.50.

Reviewed by Max Wulfinghoff

Here is a comprehensive review of the present state of the technology of aluminum, based on reasonably international surveys, and presented in an essentially chronological order of development. A staff of ten specialists, under the direction of Ginsberg, has collaborated in the writing of this text in which bibliography, patent disclosures, and actual plant performance figures have all been covered adequately. In addition, equipment and layout are discussed. The book is recommended particularly to operators, planners and researchers.

Emphasis on Instruction

MICRO AND SEMIMICRO METHODS. By N. Cheronis. Interscience Publishers, Inc., N. Y. 622 pages. \$12.

Reviewed by E. A. Steck

The series on technique, edited by Arnold Weissberger, is a worker's guide to the art, as is well known. This volume (Vol. VI) on micro and semimicro procedures has been expected for some time, during which Dr. Cheronis and his collaborators, Drs. A. R. Ronzio and T. S. Ma, have done much to produce a clear and lucid guide. There is great emphasis on instruction in the methods, with a wealth of clear and useful illustrations on apparatus, in this volume.

The divisions are arranged in three major sections: general methods; preparative reactions, including the use of tracer elements; and analytical procedures and reactions. There may be some inclination to over-teach in this book, however such fault will be found as a recommendation to the chemist who ordinarily finds it more necessary to look after packing glands than a magnetic stirrer. The sections on determination of physical constants and identification of compounds (including chromatography and tests for functional groups) should be clearly helpful to the troubleshooter. Unfortunately, there is far too little emphasis on the value of crystallographic techniques in this particular volume.

Much interesting discussion is given to neat preparative methods on a small scale—this way well provide good basic training in organic chemistry for the coming groups of chemical engineers.

No. 1

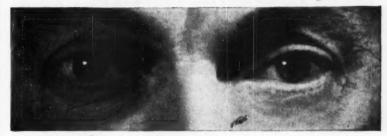
CATALYSIS. Vol. I. Edited by Paul H. Emmett. Reinhold Publishing Corp., New York. 394 pages. \$10.

Reviewed by F. C. Nachod

This is the first volume of a series on catalysis dealing with the fundamental principles. It is ably edited by Dr. Emmett and contains contributions by Drs. Ciapetta, Ladiler, Innes, Plank, Ries, Selwood and the editor. It covers such topics as physical adsorption and chemisorption, surface area measurements, kinetics, preparation of carrier, promoter, accelerator, etc., and of catalysts themselves, as well as magnetism and catalysis.

Judging the content and coverage of this first volume, the series promises to be one of the most valuable adjuncts not only to the petroleum chemist for whom it is written primarily but to anybody interested in the field of catalysis.

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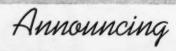
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Hills-McCanna P.V.C. valves are available in handwheel or lever operated types or with air cylinder, diaphragm motor or electric motor operators for remote or automatic control. Sizes range from ½ through 2. All regular diaphragm materials are available (rubber, Neoprene, Kel-F, Teflon, etc.). Screwed ends are standard. Slip fits available on special order.

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THIS MONTH'S

Recent Books

Flash Point Information

Flash points of about 2,400 flammable liquid trade name products are compiled in this book. In addition, each product is identified as to principal use, manufacturer and source of information. 82 pages.

"Flammable Liquid Trade Name Index," NFPA No. 324A. National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. \$1.25.

Radiation Protection

Here's a handbook, put out by the National Bureau of Standards, which contains the latest information on protection from radium, cobalt-60 and cesium-137 radiation. No specific references are made to industrial applications these will be treated in a later volume—but the basic principles discussed here can be applied to both medical and industrial uses. 60 pages.

"Protection Against Radiation from Radium, Cobalt-60 and Cesium-137." Superintendent of Documents, Government Printing Office, Washington 25, D. C. 25¢.

Index of Chem. Eng. Reports

Cataloging by subject, this book lists all publications, patents and internal reports covering a large part of TVA's chemical engineering activities. It covers the period from 1933 to 1954. 192 pages.

"Analytical Index of Chemical Engineering Publications, Patents and Reports." Superintendent of Documents, Government Printing Office, Washington 25, D. C. 55¢.

Tunnel Kiln Problems

The theme of this book centers around the firing difficulties en-

& Pamphlets

countered in operating tunnel kilns. It presents practical solutions to operating problems. Included is detailed information on the problems of firing glazed hollow tile, building brick and refractories. Twenty-one tunnel kiln firing curves are presented.

> "Operating the Tunnel Kiln," by Dr. James T. Robson. Industrial Publication Inc., Chicago 3, Ill. \$8.

Replacing Capital Equipment

A policy guide for capital equipment replacement—based on the experience of leading companies. There's a lot of information on: whether to lease or purchase, tested procedures of handling capital projects, systems for capital control. 96 pages.

"Capital Equipment Replacement." American Management Association, 330 West 42nd St., New York 36, N. Y. \$3.25.

Pressure Codes

A history of the development of ASME pressure vessel codes. After a short chapter on pre-code boiler explosions, the pamphlet traces the work of the ASME committee (appointed in 1911) and tells how the group helped to develop uniform codes. One interesting highlight—a comparison of the API and ASME codes. 28 pages.

"The ASME Pressure Vessel Code. A Joint Effort For Safe Construction." Publications Department, C. F. Braun & Co., Alham\ra, Calif. No charge.

The Optics Story

Few chemical engineers are familiar with the work that goes into making the optical instruments that are used throughout the chemical industry. This booklet tells the story. Effectively using a picture-



WHIPPING up a wind as high as 120 mph is the job of Elliott Company's Single-Stage Centrifugal Blowers. In these blowers the "tornado-builder" is a one-piece, open type, radial-bladed impeller—a Lebanon CIRCLE (**D) casting engineered to withstand unusual service conditions.

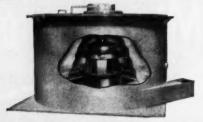
These Elliott Blowers are widely used by the Chemical (particularly in sulphuric acid plants), Power, Refining and Gas industries where they run continuously, 24 hours a day. Such difficult service requires excellence of product design and manufacture, for a stopped blower can mean a plant shut-down. That Lebanon CIRCLE (L) castings are specified by Elliott is recognition, we believe, of the superior workmanship that is traditional with Lebanon Steel Foundry craftsmen.

See—STEEL WITH A THOUSAND QUALITIES—37-min., 16 mm, full-color, sound film on the making of steel castings. For information write: Dept. F, Lebanon Steel Foundry.





Separation



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from Solids

High efficiency, low cost centrifugal dryer. There are no gears to become noisy, wear out, or require frequent replacement. There are no belts or flexible couplings.



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The McNally Pulso is an up-draft type thermal dryer. It solves thermal drying's most difficult prob-lem in the ½" to 0" range. Moisture is evaporated 100% without a drop of effluent. Surface moisture can be controlled to meet specifications.

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PAMPHLETS . . .

caption technique, you'll find material on how a new camera is designed; how analytical instruments are designed and produced; how optical instruments are used in chemical and medical work. 59 pages.

"OPTICS plus." Paul A. Wilks, The Perkin-Elmer Corp., Norwalk, Conn. No charge, but request on company letterhead.

Deaerator Heater Specs

Defining a deaerator heater as ". . . equipment in which heating is accomplished by direct contact of the steam with water . . ." this booklet has a wealth of information on standards for such heaters. There are tables of shell and head thicknesses, storage capacities and illustrations of typical arrangements of units. 11 pages.

> "Standards and Typical Specifications for De-aerators and Deaerating Heaters." Heat Exchange Institute, 122 E. 42nd St., New York 17, N. Y. \$1

Plastic Research in India

A survey of the research on plastics going on in India in various laboratories. This report covers fundamental research, work on natural resins and resin-like materials, polymers, and polycondensation products. Also, there's a chapter on the plastic industry in India, with information on methods of manufacture. 156 pages.

> "Survey of Research Problems in Plastics with Special Reference to the Development of Plastic Industry in India." Publications Division, CSIR, Old Mill Road, New Deihi, India. Rs/5-

Chemical Inventions

Published jointly by the U.S. Department of Commerce and the Small Business Administration, this book contains 1,350 brief descriptions of Government-owned inventions concerning chemicals.

The abstracts are grouped under 19 classifications, including plastics, fertilizers and drugs. These inventions are available to the public on a royalty-free license basis. 190 pages.

"Chemical Products & Processes." Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. \$3.

Rotometer Handbook

A complete rotometer guide. There's a wealth of information on rotometer size selection, flow corrections factors, material and design recommendations and calibration curves for various rotameter sizes. Designed as a working manual as well as a design manual, it can be used in solving operating problems. 250 pages.

"Brooks Rotameter Handbook." Brooks Rotameter Co., Lansdale, Pa. \$20.

Cast Stainless Data

You'll find information here on 13 cast corrosion resistant alloys. Published in data sheet form, each sheet contains information on composition, physical properties, mechanical properties and design considerations. 26 pages.

"Cast Stainless Alloy Data Sheets." Alloy Casting Institute, 32 Third Ave., Mineola, N. Y. No charge.

Safety Code

Here are British recommendations on how to store and use highly inflammable liquids. In the form of a safety circular, it deals in a general way—with methods for minimizing the hazards involved in handling such liquids.

> "Code for the Storage and Use of Highly Inflammable Liquids." Association of British Chemical Manufactures, Cecil Chambers, 86, Strand, London W. C. 2. 50¢.



Here's another good example of processing equipment being manufactured to order in our shop. It's a heat exchanger for taking care of a heat transfer step at extremely low temperatures.



Our manufacturing service is twofold:

1. To design and manufacture special equipment to meet certain processing requirements. We are technically staffed to do this kind of work.

2. To manufacture to customer's own design. We are well equipped shop-wise, working with modern machinery and utilizing the latest technique in fabricating, welding, coiling, heat-treating, etc. We are experienced in handling every commercially used metal.

This heat exchanger was manufactured to the customer's own design, thus bringing it under the second phase of our service referred to above. But our broad knowledge of heat transfer for both high and low temperature use and appreciation of what such equipment is up against were of no small value in this work. In a broader sense, our understanding of many industrial operations comes in very handy when working on processing equipment.

Why not consider our design and/or manufacturing services for the equipment you need?

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ment replacement. A complete analysis must include shutdowns, lost production time, product contamination and spoilage, fume damage to buildings and associated equipment, possible injury to personnel. Compare this myriad of costs against the single outlay for Tantalum, the metal that is not merely "corrosion-resisting", but acid-proof.

If you are processing hot or strong acid solutions, if you are making a pure product in which equipment contamination or side reactions cannot be tolerated, tantalum is probably the most economical material of construction you can use. Experienced Fansteel engineers are at your service for consultation at no cost to you.

Use Tantalum with economy for most acid solutions and corrosive gases or vapors except HF, alkalis, or substances containing free SO₃.



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"Acid-Proof Tantalum Equipment for Chemical Operations"

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THIS MONTH'S

Firms in

New Lines

- Armstrong Cork Co. has entered the soft-surface floor covering business through an agreement to acquire the stock of the Deltox Rug Co., Oshkosh, Wis.
- Polymer Industries, Inc., Adhesive Div., will produce the metal bonding adhesives formerly manufactured by the ChemoTec Div. of Eutectic Welding Alloys Corp.
- St. Regis Paper Co., Panelyte Div., has entered the field of vacuum forming to diversify its services in the larger area of plastic products.
- Allied Chemical & Dye Corp., Solvay Process Div., has added methyl chloride, methylene chloride, chloroform and carbon tetrachloride to its line of alkali chemicals through the opening of its Moundsville, W. Va., chloromethane plant.
- Pantex Mfg. Corp., Pawtucket, R. I., has acquired the complete line of plug valve actuators formerly produced by Valve Controls, Inc.

New Representatives

- Insul-Mastic Corp. has named Carter-Bearden Co. as its new representative for heavy asphaltic coatings, in Atlanta, Ga.
- Arapahoe Chemicals, Inc., has appointed E. C. Godwin & Associates, Montreal, Que., as its sales agent.
- Lehigh Chemical Products Co., Chestertown, Md., has selected Kessler Corp., Washington, D. C., as agent for its synthetic lubricants.
- Metal Textile Corp. has appointed Metal Goods Corp. as distributor for its Metex mist eliminators.

the News

M. A. Gibbons

New Facilities



Shell Development Co. has constructed three new buildings in Emeryville, Calif., to house research and development activities.

Argonne National Laboratory has selected Sargent & Lundy, Chicago, to design its proposed experimental boiling water reactor for the development of competitive electrical power from nuclear fuel.

Robertshaw-Fulton Controls Co. has opened its \$1 million research center for the development of new industrial control devices.

Fluor Corp., Ltd., Los Angeles, has purchased a majority interest in Singmaster & Breyer, Inc.

Borg-Warner Corp. has acquired Weston Hydraulies Ltd., No. Hollywood, Calif., manufacturer of hydraulie and pneumatic equipment.

Perkin-Elmer Corp., manufacturer of scientific instruments, has formed a Vernistat Div. to handle the manufacture of a variable ratio-transformer.

Canadian International Paper Co. has purchased the Quebec woodland holdings and bleached sulfate pulp mill of the Brown Corp., Montreal.

American Chain & Cable Co., Inc., Bridgeport, Conn., has purchased The Bristol Co., Waterget acquainted with the newest addition to

the WILLIAMS LINE of

COPPERAS TYPE PURE RED IRON OXIDES

OUR NEW 100 SERIES

-- Available in 6 Shades ranging from a Light Salmon Red to a Medium Maroon R-2200, R-2900, R-3200, R-3800, R-4800, R-5800

Broad range of applications includes paints, rubber, building materials, leather finishes, plastics, paper, etc. Let our samples prove the value of these pigments. See your Williams representative or write us direct.

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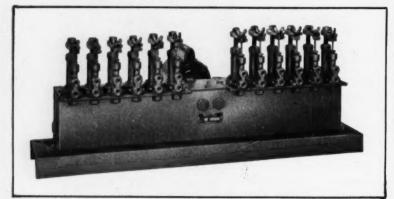
Got a Chemical Feeding Problem?



MANZEL

can help you solve it!

The flexibility of Manzel Chemical Feeders permits the accurate feeding of many different chemicals simultaneously — at a rate from a few drops to 60 gallons per hour. Adjustment is easy and the simple Manzel design insures trouble free operation. Where special problems call for specially engineered installations, the Manzel organization has the ability to deliver.



It's Manzel, too, for Force Feed Lubricators

Where efficient, economical operation depends on pressure lubrication — in exact amounts — accurately timed — Manzel Force Feed Lubricators are your answer.



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FIRMS . . .

bury, Conn., manufacturer of industrial instruments, for \$7½ million.

Ebasco Services Inc. has opened an office in Portland, Ore.



Permatex Co., Inc., Kansas City, Kans., has dedicated its new \$500,000 chemical plant for the production of chemical sealants.

Continental Can Co. has purchased the American Paper Goods Co., Kensington, Conn., manufacturer of paper cups, envelopes and bags.

American Potash & Chemical Corp., Trona, Calif., has put into operation its new \$150,000 dust-proof control laboratory for the constant testing of chemicals.

Svenska Shell, Rasta, Sweden, has opened a lubricants blending and packaging plant, capable of handling over 20,000 tons annually.

Corn Processing Div. of Clinton Foods and National Starch Products are considering a merger.

Chicago Corp. has awarded a contract for the construction of a new fluid cat cracking unit at Enid, Okla.

Glidden Co., Ltd., has opened its new paint and enamel mfg. plant which cost \$600,000.

du Pont Co. of Canada Ltd., Maitland, Ont., will erect a plant for the manufacture of freon fluorinated hydrocarbons.

Pan American Suphur Co. has put two sulfur wells into production in Mexico. Winthrop-Stearns Inc., New York, will locate its west coast headquarters in Menlo Park, Calif.

Wagner Bros., Inc., manufacturer of metal finishing equipment, has consolidated all its facilities in a new plant in Detroit.

Simpson Electric Co., Chicago, has purchased the plant facilities of O. D. Jennings & Co.

Assembly Products, Inc., builders of moving coil relays, will consolidate all its facilities in a larger plant in Chesterland, Ohio.

Tide Water Associated Oil Co. has launched its fourth tanker, the \$6 million "Flying A Washington."



Newage International Inc. has opened its new factory in Toronto for Newage (Canada) Ltd.

Clark-Hopkins Equipment Corp. has moved to its new facilities in Montgomeryville, Pa.

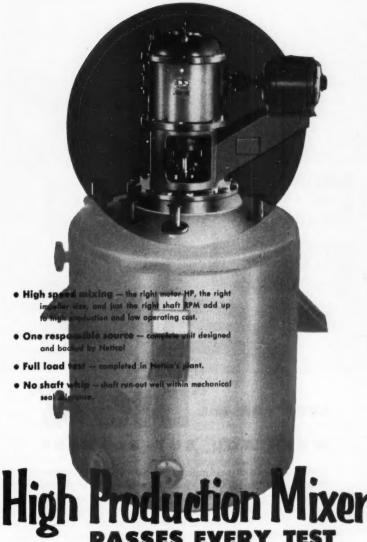
E. I. du Pont de Nemours & Co. has opened new district offices in Chicago and Los Angeles, for its Kinetic Div.

Lithium Corp. of America, Inc., has opened a sales office in New York City's Lincoln Building.

Structural Clay Products Research Foundation will construct a new national research center in Chicago.

Chase Products Co., custom aerosol fillers manufacturer, has opened a 30,000 sq. ft., \$250,000 plant in Broadview, Ill.

Continental Uranium Co., Chicago, has bought a uranium mine



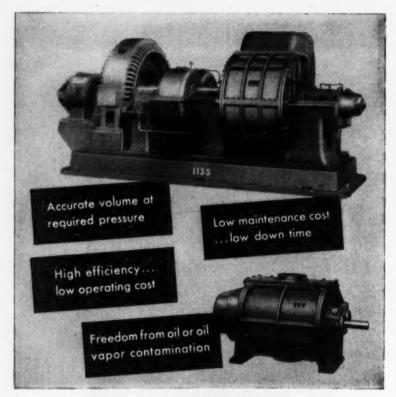
This agitator — the product of Nettco equipment and Nettco engineering

- answers eight full pages of engineering specifications drawn up by one of the nation's largest chemical manufacturers. There was a lot of satisfaction in hearing our customer report: "OK on all counts".

Nettco can help you at every stage in the development of agitation systems: preliminary design, preparation of specifications, manufacture of agitating equipment to meet rigid specifications, and pre-testing of the

Next time see Nettco . . . for money-saving, time-saving agitation. New England Tank & Tower Co., 87 Tileston Street, Everett 49, Mass.





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Successful over-all performance of blowers calls for continuous, long-time ability to meet these basic requirements. In any specific case, one may be more important than another. But, when you select Roots-Connersville equipment, you sacrifice none of these four essentials. That is true, whether your requirements are for a whisper of air or for a tornado. You'll find the R-C range of capacities so extensive that you can very closely match your needs, with resulting economies in both first cost and operating cost. Further, you have the choice of either Rotary Positive or Centrifugal Blowers, from the exclusive R-C dual-ability line.

The ability to deliver blowers with these fundamental values comes from our century of specializing in problems of handling gas and air. The proof of this ability is readily found in our list of long-time customers who have gained complete satisfaction by entrusting their blower problems to Roots-Connersville. Ask us about your present or future needs in equipment to handle gas or air.



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Specialists in handling gas and air

FIRMS . . .

in Lisbon Valley, Utah, from Old Texas Mining Co., Dallas, for \$4 million.

Leinart Eng. Co., distributor of Parker tube and hose fittings, has opened a stocking warehouse in Atlanta, Ga.

American Viscose Corp. has established an acetate section in its research and development division, in Marcus Hook, Pa.

Towmotor Corp., Cleveland, plans the construction of a new plant which will increase and centralize production facilities.

Batelle Memorial Institute, Columbus, Ohio, plans to expand its nuclear-energy research program at a cost of \$1½ million,

Tapecoat Co., Evanston, Ill., has opened a west coast office in the San Francisco area.

J. T. Baker Chemical Co., Phillipsburg, N. J., will construct a new research laboratory building.

Westinghouse Electric Corp., will spend over \$3 million to expand facilities for the production of room air conditioners.

Warren Petroleum Corp. has begun operations at its new 200,000 bbl. natural gasoline terminal in San Pedro, Calif.

Sunray Oil Corp. has put its new 9,000 b/d delayed coking unit on stream in Duncan, Okla.

Wolverine Tube, Div. of Calumet & Hecla, Inc., has opened a new bonded mill depot in Rochester, N. Y.

Reichhold Chemicals, Inc., is constructing a formaldehyde producing installation at its Charlotte, N. C., plant.

Dow Chemical Co. has opened a Chicago terminal office to provide improved customer service in the midwest.



Colgate-Palmolive Co. has established a new radioisotopes laboratory for research in soaps and detergents, in Jersey City, N. J. (Above tagged atoms are traced in a Q-gas counter.)

Zep Mfg. Corp., producer of industrial chemicals, has opened new quarters in Dallas for manufacturing purposes.

West End Chemical Co. has begun construction on a salt cake unit at Westend, Calif., in conjunction with soda ash operations there.

Jones-Dabney Co., Div. of Devoe & Raynolds Co., has begun construction of a new manufacturing plant in Louisville, Ky.

Columbia University has just completed its \$1 million geo-chemical laboratory at the Lamont Geological Observatory, Palisades, N. Y.

Techalloy Co., Inc. has just completed its \$4 million expansion of facilities in Rahns, Pa., for the production of industrial equipment.

B. F. Goodrich Co. has purchased the Sponge Rubber Products Co., Shelton, Conn.

Food Machinery & Chemical Corp. has established corporate export offices in New York City.

Tar Products Div., Koppers Co., Inc., has begun construction of a terminal operation on Presidents Island near Memphis.

E. I. du Pont de Nemours & Co., Inc., Wilmington, will soon com-

Another (7) first-0.03 Max. Carbon Stainless Castings



...to stop CORROSIO even at the weld

Now, for the first time you can specify 0.03 Max. Carbon stainless castings, in many forms, for greater corrosion resistance. ESCO offers static and centrifugal castings in all 18-8 and 18-8 MO analyses, which are guaranteed to contain a maximum of only 0.03 per cent carbon.

No Carbide-Dissolving Anneal **Needed After Welding**

Most castings must be welded to component parts during installation. The higher the carbon content of a casting the more "carbide precipitation" during welding. Carbide precipitation often means severe corrosion adjacent to welds-unless the casting is heat-treated after welding. Heat-treating after fabrication is an always difficult, sometimes impossible job.

ESCO 0.03 max, carbon castings can be welded into working position and be ready for action immediately without loss of corrosion resistance. Result: Dependable, corrosionresistant operation. A definite cut in operating costs.

Excellent Welding Characteristics

ESCO 0.03 max, carbon castings may be welded as easily as any 18-8 grade of stainless-without harmful carbide precipitation.

Available Now

ESCO welcomes your inquiries on 0.03 max, carbon castings and a wide variety of other static and centrifugally-cast stainless and high alloy products.

We are equipped to produce to your specifications on one casting or an entire installation. If you prefer, our high alloy engineers will make a complete study of your corrosion problems. Or write for booklet 175, Esco Stainless and High Alloy Products for the Process Industries to: Electric Steel Foundry Company, 2162 N. W. 25th Avenue, Portland 10, Oregon.

... the toughest corrosion problems wind up at ...



ELECTRIC STEEL FOUNDRY CO.

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International Division and New York Office 420 Lexington Ave., New York City, N. Y. Other Offices and Warehouses Los Angeles, Catif. Centrolia, Pa. San Francisco, Catif. Houston, Texas Saatte, Spokane, Wash. Medford, Eugene, Ore.

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Equip Your SAFETY HEADS With BS=B Kel-F Lined

Rupture Discs!

Whenever BS&B Safety Heads are installed in a location where corrosive conditions exist, an unprotected metal rupture disc may be vulnerable to corrosive attack from either the product or the atmospheric side—or both.

The recommended disc to use under these circumstances is the BS&B Kel-F lined rupture disc, which has for more than 3 years proven its resistance to corrosive attack from strong acids, caustics, chlorine, etc. Kel-F is a trade name for a thermo-plastic film of trifluorochlorethylene, which is also known by the trade name of Trithene. Discs may be specified with the Kel-F lining on either or both sides, as your conditions may require.

The use of Kel-F linings in combination with metals of known mechanical and metallurgical qualities such as Inconel, Monel, stainless steel and nickel means positive, trouble-free protection in highly corrosive applications heretofore impossible.

Thus, through "know-how" attained by years of experience in this highly technical field, BS&B has again provided the Process Industries with a better safety device for the protection of closed pressure systems!

For full information on the BS&B Kel-F lined rupture disc and its application to your specific problem, consult your BS&B Office or Representative...or write to us direct.

THE "CIRCUIT-BREAKER" OF
Any Pressured System



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Safety Head Division, Dept. 2-H12 7500 East 12th St., Kansas City 26, Ma



FIRMS . .

plete a total of 10 new units for industrial research.

Kaighin & Hughes, Inc., piping and mechanical contractor, has organized an Industrial Wastes Div. in Toledo, Ohio.

Container Corp. of America has acquired more than half the total shares the common stock of the Mengel Co.

Minnesota Mining & Mfg. Co. will build a plant at Guin, Ala., for its reflective products div.

American Sulphur & Refining Co., Beverly Hills, Calif., has acquired exclusive license to a sulfur ore extraction process from Standard Oil Dev. Co.

Hilton-Davis Chemical Co. and Amritlal & Co., Ltd., will sponsor the construction of a plant for the manufacture of dyestuffs, in Bombay.

Thompson-Hayward Chemical Co., Kansas City, has purchased seven plants of Carman & Co., Inc., New York.

American Forest Products Corp. will begin constructing its Newark, Calif., \$2½ million corrugated box plant this month.

Procter & Gamble Co. will lease the detergent producing facilities of Establissements Fournier-Ferrier, Marseilles, France.

Air Reduction Co. is enlarging its Hygirtol hydrogen plant in Louisville, Ky., with addition of parallel purification facilities.

Beckman Instruments, Inc., Berkeley Div., has organized an integrated engineering group to provide complete service for installation of control systems.

Lever Bros. Co. has opened its new Chicago warehouse which employs a high degree of automation in its materials handling system.



Institute of Gas Technology has opened its \$½ million research laboratory in Chicago.

Tehuantepec Co., Houston, will build a sulfur plant in Vera Cruz, Mexico.

Reichhold Chemicals, Inc. has affiliated with Bergviks Hartsprodukter AB (Sweden).

New Companies

Gain Corp., new subsidiary of Fredik A. Stresen-Reuter, Inc., will market automotive additives for mass consumer use.

Johnson-Davis Co., Chicago, will represent manufacturers in the sale of industrial products.

Watson-Stillman Internationale Maatschappij, N. V., Rotterdam, will operate as a wholly owned subsidiary of Watson-Stillman Co.

New Names

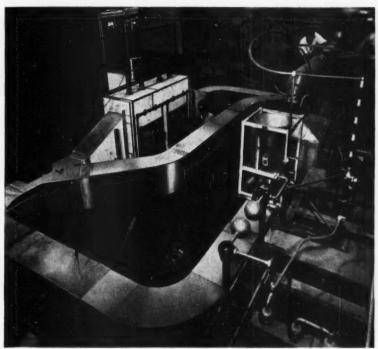
B-I-F Pacific, Inc., is the new name for Builders-Pacific, Inc., west coast affiliate of B-I-F Industries, Inc., Providence, R. I.

New Locations

John B. Moore Corp., manufacfacturer of industrial solvents, has moved to the Peerless Bldg., 384 Franklin Ave., Nutley, N. J.

U. S. Hoffman Machinery Corp. has centered all its production facilities in Wilkes-Barre, Pa.

Colgate-Palmolive Co. will move its Jersey City, N. J., office personnel to the new Colgate-Palmolive Bldg. at 300 Park Avenue, New York, N. Y.



Precipitator pilot plant, Verona Rosearch Center of Koppers Company, Inc.

Why Koppers Electrostatic Precipitators work so well

The answer to why Koppers Electrostatic Precipitators work so well is to be found in the sound engineering principles followed, from the project stage right through to actual installation... application engineering "know-how."

The wealth of experience gained over the years in designing and building equipment for cleaning gases provides the basis for such "knowhow." In addition, foreign installation and engineering data is available to Koppers engineers through special agreements . . . Koppers experts are kept up-to-date on new process developments on a world-wide basis.

Koppers also has extensive labora-

tory facilities to analyze plant processes and problems in industrial gas cleaning. It has pilot equipment and competent personnel to conduct conclusive tests.

It's this knowledge, this experience, these facilities that make for satisfactory service . . . service for which Koppers has long been famous.

Next time you have a gas cleaning problem, remember that every problem is different, every problem contains variables which must be correctly analyzed before a satisfactory solution is reached. So it will pay you to consult Koppers... the company with application engineering "know-bow." Mail coupon for additional information.



METAL PRODUCTS DIVISION
• KOPPERS COMPANY, INC.

RAUTIMORE 3, MD. This
Koppers Division also supplies
industry with Fest's Couplings,
American Hammered Industrial
Piston and Sealing Rings, Aeromaster Fans, Gas Apparatus.

Engineered Products
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KOPPERS COMPANY, INC., Electrostatic Precipitator Dept.
312 Scott St., Bultimore 3, Md.

Gentlemen: I am interested in an analysis and recommendations for my operation. I understand I am under no obligation.

Name......



... you can read any surface temperature in your plant ... accurately and easily ... with the Alnor Portable Pyrocon.

Compact in size, complete in precision design and workmanship, this rugged instrument assures the highest standards of speed, accuracy and dependability. You can take temperature readings on materials in process, the finished product or the heated equipment itself—in as few as 3 seconds!

Alnor Portable Pyrocons come in scale ranges to 2000° F., with thermocouples for every application. You'll find full details on the Pyrocon exactly suited to your operations in Bulletin 4257. Send for your copy now. Write: Illinois Testing Laboratories, Inc., Room 559, 420 North LaSalle Street, Chicago 10, Illinois.

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Portable Conveyor
and a B-G Car Unloader
unloaded a car of coal in

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MINUTES
see your B-G distributor

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PROPELLERS

for MIXING, STIRRING, AERATING, PUMPING, etc.

Manufactured by an exclusive process, MICHIGAN propellers are perfectly balanced to avoid whip and strain on shafts. And because of their superior functioning are now standard parts of the products of many leading equipment manufacturers.



Available for special application and replacement, as well as original equipment, in a wide variety of metals and in sizes up to 40". Write for latest data folder.

MICHIGAN WHEEL CO.

LEE

CORROSION-RESISTANT

Lee Kettles meet every processing need. They are practical, easy to clean and keep clean, meet all sanitary regulations and are available in sizes up to 500 gallon capacity.

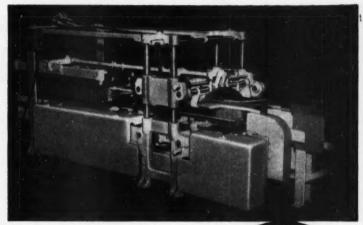
For longer service and greater allaround dependability, specify LEE Corrosion-Resistant Kettles.

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ALL LEE KETTLES ARE MADE TO A.S.M.E. CODE



meet shorty

BIGGEST LITTLE LABOR-SAVER YOU EVER SAWI

SHORTY has it all over any other method for preparing cases for shipment.

You can forget tapes, staples and straps, and the labor costs that go with them. SHORTY does everything automatically and discharges cases with flaps neatly squared and tightly scaled.

It's so compact, it will fit anywhere. It adjusts easily to a wide range of case sizes. It will glue and seal seven cases per minute and better, depending upon case size and your requirements. It will pay for itself in no time.

FOR BETTER LOOKING SHIPPING CASES AT LESS COST, GET THE FULL DETAILS ON "SHORTY" BY WRITING TO DEPT. V, STANDARD-KNAPP, DIVISION OF EMHART MFG. CO., PORTLAND, CONN. HIGH SPEED GLUERS AND SEALERS FOR HIGH VOLUME PRODUCTION LINES ALSO AVAILABLE.





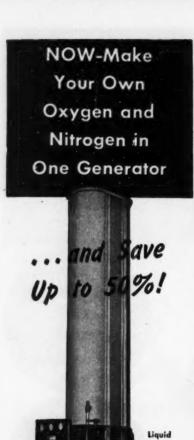


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DIVISION OF EMHART MEG. CO

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Only the best is good enough



With INDEPENDENT'S newly-designed generators, you can make your own high-purity oxygen and nitrogen from the free air . . . and in the same generator.

Oxygen

You reduce costs up to 50% by eliminating handling costs . . . vaporizing costs . . . evaporation losses . . . residual losses . . . and transportation

INDEPENDENT Generators are available in any capacity, any purity and any pressure. Put your oxygen-nitrogen problem up to us... our engineering department will gladly submit recommendations . . . no obligation, of course!

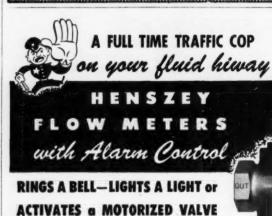
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O'FALLON 7, ILLINOIS



MAYNUFACTURING CORP. SOUTHPORT: CONN



There are only three moving parts in the HENSZEY FLOW METER—no breakdown due to complicated gears and mechanism. Goes right in the line—no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.

SOUND ALARM AT HIGH OR LOW FLOW!

Easy to set on face of switch

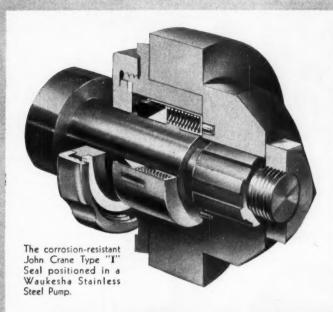
unaffected by dust, dirt
or corrosion — no pitting or
sticking.

HENSZEY COMPANY

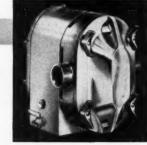
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The P.D.* Pump for the chemical and petroleum industries



the seal of toughness



Waukesha Stainless Steel Pump for the Chemical Industry—

one of a broad line of quality positive displacement pumps.

...in corrosionresistant pumps

Designed for a "tough" pumping job in the

chemical industry where volatile, corrosive, or hot materials are being transferred is the Waukesha positive displacement pump with the spring-loaded, John Crane Rotary Seal.

Incorporating carbon, ceramic, and teflon, this seal is recommended for non-abrasive products having corrosive properties.

Waukesha positive displacement, corrosion-resistant, stainless steel pumps are renowned for their precision performance and dependable operation in many industries.

These pumps require a minimum of time to dismantle, clean and assemble. They are easy to wash and sterilize... a valuable asset where pumps are used to handle various products one after another. Write Waukesha, today, for complete details.

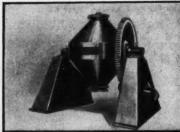
The Waukesha Positive Displacement Pump of Stainless Steel.



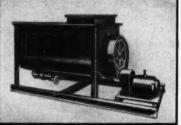
In Mixing and Processing Equipment



building a new plant, or expanding your present facilities, be sure to check with INTERNATIONAL for the latest engineering developments in improved equipment for the correct and most economical blending, treating, mixing and grinding—Remember INTERNA-TIONAL manufactures and guarantees the equipment you need in any required sizes and capacities.



DRY BLENDERS From 25 to 10,000 lbs.

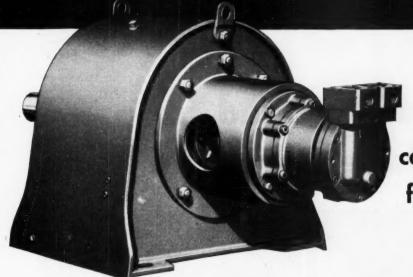


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NOW! NEW OILGEARDUCERS



Offering for the first time compact, packaged, fluid power output drive units!

 Oilgearducers are new integral output drive units combining Oilgear Fluid Power axial piston motors and Falk All-Steel Reducers. There are horizontal and vertical models, concentric and right angle types and single, double, triple and quadruple reduction. Now, for the first time you can get a complete, easy to install, "ANY-SPEED" output unit for your high torque, low maximum speed drives. When used in combination with Oilgear Fluid Power Pumps, these reversible Oilgearducers provide infinite variability of speed, absolutely controlled rate of acceleration and deceleration, smooth and swift reversal, cushioned braking. All these together with major economies in motor, circuitry and power requirements. This new Oilgearducer "Any-Speed" output unit is available in sizes from 1 to 20 h.p. It is unequalled for applications as diverse as canfilling, paper machines, centrifugals, cable wrappers...and in automation or feed back applications where synchronization is an absolute necessity. Write now for new bulletin 56610. THE OILGEAR COMPANY, 1579 West Pierce Street, Milwaukee 4, Wisconsin.

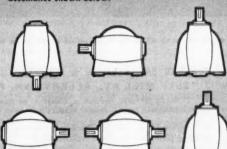


FOR FLUID POWER

PUMPS, MOTORS, TRANSMISSIONS, CYLINDERS & VALVES



essemblies shown below.

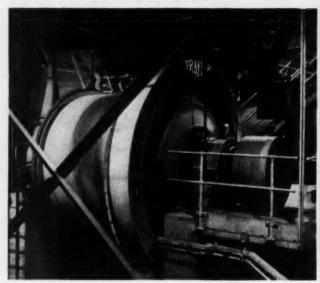


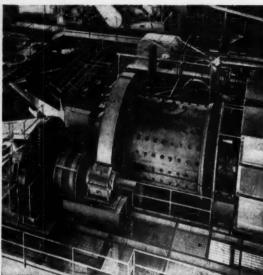


Write for this new **Bulletin 56610**

new grinding requirements

indicate a need for 'Traylor-Made" Grinding Mills





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SALES OFFICES: New York . Chicago . San Francisco CANADIAN MFRS: Canadian Vickers, Ltd., Montreal, P. Q.

A "Traylor-Made" mill is probably the answer to my current grinding problem. Send me bulletin 8121.

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In producing a new or improved product, consider carefully your grinding operation. Trying to use mills originally installed to grind other products may prove to be an expensive economy. Just as every material you produce has to meet certain finished specifications, the mill used to grind that material must possess certain individual characteristics. No grinding mill can possibly be as efficient and economical to operate as a mill "Traylor-Made" for its special process. Traylor Bulletin 8121 will show why a "Traylor" leads to greater profits. Mail the coupon for your copy today.













Primary Gyratory Crushers

The speed you want ... where you want it! Single reduction gearmotor with Elliott C W brake, A complete integral power unit. Low speed shaft can be located with reference to motor center line in any of four positions-above. (as shown) at right, left, CROCKER-WHEELER motors Here is a complete line of motors with built-in reduction gear units which covers practically every need. Double reduction gear on an Elliott C-W Form BA Available in any motor type, any enclosure, any mounting, in frame sizes from 1 to 150 hp. squirrel cage Single reduction, 780 to 280 rpm...double reduction, 230 to 45 rpm...triple reduction, 37 to 7.5 rpm. Construction features include precision processed, file-hard gears, large oil reservoir for abundant splash lubrication, heavy, rigid cast iron pyramidal base, and a bearing housing and oil seal separating the inner high speed motor bearing from the gear lubri-

GET THE GEARMOTOR DATA BOOK

cation, which after much service may contain minute metallic particles tending to shorten bearing live.

- ask your local Elliott District Office or write direct to Elliott Company, Crocker-Wheeler Division, Ampere, N. J.



ELLIOTT Company

CROCKER-WHEELER DIVISION



Triple reduction unit mounted on an Elliott C-W totally enclosed fan cooled "Searedpower"

explosion-proof motor.



PECTIN from ORANGE PEEL ... and Inconel protects purity

The "blanket" you see here is the pulpy remains of a few thousand orange peels. From it this rotary vacuum string filter is separating hundreds of gallons of pectin-containing liquor.

Before the pectin could be obtained in soluble form, however, hydrochloric acid had to be added to the slurry which was then boiled. This raised a problem of corrosion and of protecting the pectin from "metallic pick-up."

The Exchange Orange Products Company, Ontario, California, solves this problem by using corrosion-resisting Inconel for all contact parts in the filter. The sweep agitators in the extraction tanks and the evaporators are Inconel as well.

When you have a problem of product purity in your processing, think of Inconel for your equipment. Inconel has practically complete resistance to corrosion by organic acids as they occur in food products including fruit juices and alcoholic beverages. It is also used in many other applications where purity is all-important, such as streptomycin and penicillin fermentation tanks, film processing equipment, and equipment handling silver salts, dye solutions and rayongrade caustic solutions.

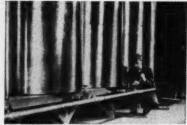
Need any help in selecting an alloy to protect product purity? Inco's Corrosion Engineering Section will be glad to help you without cost or obligation. Write, giving full details of your problem.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.



WHEN "METALLIC PICK-UP" IS A PROBLEM . . .





Liquor stored in Inconel tanks — A Canadian Liquor Commission has installed thirty 450-gallon Inconel tanks for liquor storage. Easy to clean and maintain, Inconel tanks protect the color, flavor, and other qualities of high-proof liquors.



Inconel, walds easily, too — And Inconel weld joints are just as corrosion-resisting as the metal itself. They need no subsequent heat treating; speed fabrication.

MONEL® • "R"® MONEL • "K"® MONEL
"KR"® MONEL • "S"® MONEL • INCONEL®
INCONEL "X"® • INCONEL "W"®
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how

FILM MAKERS
CUT CASTING,
CHILLING,
DRYING COSTS

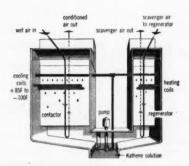
The leading manufacturers of photographic film and paper needed dry air at low temperatures for their casting, chilling, and drying processes. And they wanted it without frost, excessive reheating or aftercooling, high power requirements, carry-over, corrosion, and high maintenance and service costs.

They obtained air at the precise conditions they wanted by installing Kathabar humidity conditioning units, and avoided problems common to other dehumidification systems. For the casting process, where film dope changes from a viscous liquid to a transparent strip, Kathabar units deliver air at 104F and 47.5 grains/lb. with 53F water. For chilling the emulsion, they deliver air at 6.5F, 5 grains/lb., frost-free with OF refrigerant. For drying the emulsion, they provide 140F, 36-grain air, with 75F water.

The results have been better process control, improved product quality, and lower costs. One manufacturer, for example, saved \$40,000 annually in excess refrigeration by using Kathabar units for drying photographic paper.

Similar results have been achieved with Kathabar units in other industries: foods, pharmaceuticals, petrochemicals, brewing, glue, candy, atomic energy, lithography. For details, write for Literature Group K54-1C, including our just-published brochure, "HUMIDITY CONDITIONING."

WHAT COULD BE SIMPLER?



Air to be conditioned passes through the contactor, where an absorbent solution removes moisture (the amount depends on the automatically-controlled temperature of the solution). In the automatic regeneration, about 15% of the solution is heated, and the moisture it releases is blown out the window.



SURFACE COMBUSTION CORPORATION . TOLEDO 1. OHIO

ALSO MAKERS OF Surface INDUSTRIAL FURNACES .

Janitrol AUTOMATIC SPACE HEATING

"Inter-Floor Handling?...

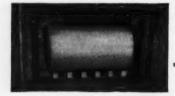
.. check Gifford-Wood"

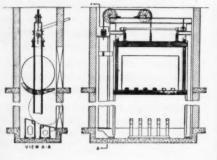
That's right...no need to let your plant operations bog down because of knotty inter-floor handling problems. Over the years, G-W engineers have successfully met the varied requirements for handling many different items in dozens of different industries. And while G-W doesn't have the answer to your problem, per se, they have what is more important -the background of proven accomplishment.

Here's proof ... This G-W System Ups Efficiency 871/2% A large eastern can company now handles in one hour the same tonnage of sheet steel that previously required eight.

This G-W System Saves **Costly Plant Space in** Metropolitan New York

A big New York daily newspaper saves valuable space, handles ¾ T. newsprint rolls faster, easier, more safely with this G-W Pneumatic Drop.







The answer to your specific problem undoubtedly is not represented here, but the experience necessary to find that answer is. For complete information on any of these three G-W inter-floor handling systems, or for Materials Handling Catalog #400, please

GIFFORD-WOOD CO.

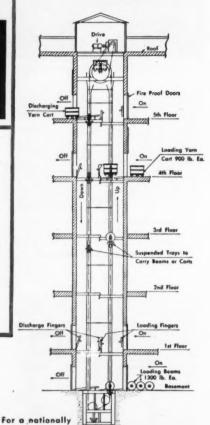
Since 1814 - Hudson, New York

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This G-W System Saves \$25,000.00 Annually



known textile and rubber company this system handles heavy rayon beams and box trucks safely, with less muscle work, through six stories, automatically loading and discharging.



COOLING LEAN OIL?



FOR MAXIMUM HEAT TRANSFER EFFICIENCY SPECIFY

Wolverine Trufin*

TYPE L/C

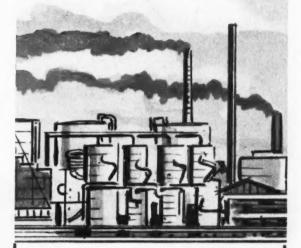
If you want top heat exchanger performance, you'll do yourself a good turn if you specify Wolverine Trufin Type L/C condenser tube.

Type L/C is a bi-metal tube designed expressly for air-cooled heat exchangers. Its integral finned construction provides a reliable extended surface condenser tube which gives maximum heat transfer efficiency at a minimum cost.

In addition to possessing excellent heat transfer features, Type L/C boasts the inherent ruggedness of all Trufin integral-finned tubing. These qualities—along with Wolverine Tubemanship—assure the stand-up stamina required for tough jobs.

You'll find that Trufin will answer almost any heat exchange problem. Trufin is produced in copper, copper-base alloys (including inhibited Admiralty and 90-10 cupro-nickel), aluminum, and electric-welded steel. Trufin Type L/C is supplied with integral aluminum fins and the liner material which is best suited to the job requirements.

*REGISTERED U. S. PATENT OFFICE



Service of Unit	Lean Oil Cooler

hour

Tube Side Fluid Lean oil

Total fluid entering tube 390,000 #/hr.

side

Type of Condenser tube Wolverine Trufin Type

used L

L/C

Integral aluminum fins

Admiralty liner

EXAMINE THIS SERVICE

Effective? Sure! Unusual? No! This is only one of the many applications where Trufin Type L/C Condenser tubing is used in the processing industry.

For page-packed information and complete case histories, write today for the Trufin "Opportunity" book. Wolverine Tube, Division of Calumet & Hecla, Inc., 1443 Central Avenue, Detroit 9, Michigan.



WOLVERINE TUBE

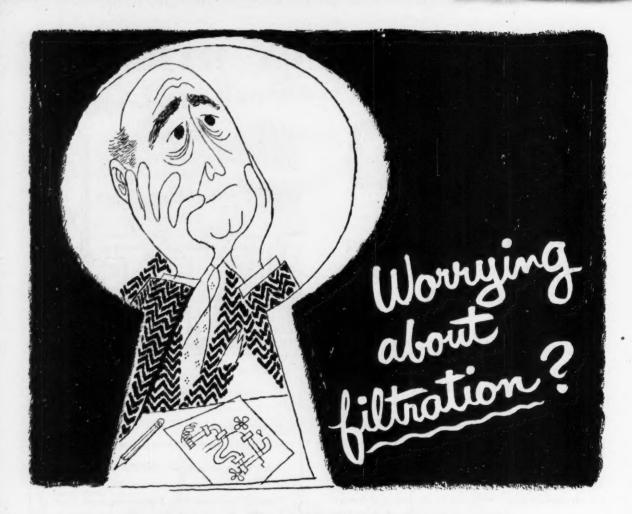
DIVISION OF CALUMET & HECLA, INC.

Manufacturers of Quality Controlled Dubing and Extruded Aluminum Shupes

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ont.

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

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Purolator maintains the world's largest specialized filter research and engineering laboratories ... always ready to serve you!

Your filter problems-small or large-are always welcome at Purolator's Engineering Department.

If you find that none of the nearly one thousand types of standard Purolator* filters will fill the bill we'll design one especially for you!

But before you decide on a custom-designed unit, you'll want to study the many kinds of Purolators available on order. The large, illustrated Purolator *Reg. U. S. Pat. Off.

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Whether you need one special filter, or a million of a kind . . . your best source is Purolator!

There's a PUROLATOR for every filter need

Here's the KEY to your filter problems-

Purolator Products, Inc., Rahway, N. J.

Send the following Purolator catalogs:

□ Industrial □ Aviation □ Automotive

In your opinion, which pinion?



In an internally geared motor the pinion on the motor shaft is the vital link between motor and gearing. It's the fastest, but smallest gear, so it must be extra strong, free from vibration and forever tight. Now compare the U. S. Syncrogear motor pinion with the ordinary type. Note the extra large section area of the U. S. design. It has a long solid shank that anchors into the motor's hollow shaft, whereas the ordinary shell type has a small section area, short keyed.

Obviously the U. S. design is most substantial, longer lasting, more resistant to deflection and can carry high speed loads far more safely than common designs. All the gears are deep-hardened and shaved to exact tolerances in the U. S. plants.

Added life lengthening features

The rugged pyramidal case supports the motor and gear train and all castings are normalized to insure permanent alignment and to prevent distortion. The motor windings are asbestos-protected to avoid carbonization and guard against burnouts. All moving parts are completely enclosed for weather and dust protection and confined within the least cubical dimensions on a single mounting. ½ to 30 h.p.; 10 to 10,000 r.p.m.

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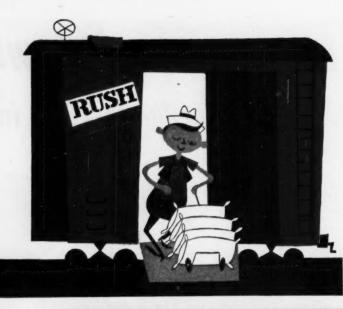
BUILT-IN PINION U.S. SYNCROGEAR



Angeles 54, Calif.

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Kaiser Alumina delivered on time...





thanks to our fast, dependable delivery!



And to meet emergency requirements We often deliver overnight!

This Unsurpassed service has helped make Kaiser Chemicals a supplier of calcined and hydrated aluminas to more than 80% of the nation's users.

Whether you manufacture abrasives, glass, ceramics, refractories, catalysts, or chemicals for water treatment, Kaiser Chemicals Division has the product, the service and the technical assistance to meet your needs exactly. We'll give *immediate*, *individual attention* to your order.

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12, California, 1924 Broadway; AKRON 8, Ohio, First National Tower Bldg.; CHICAGO, 518 Calumet Bldg., 5231 Hohman Ave., Hammond, Indiana.

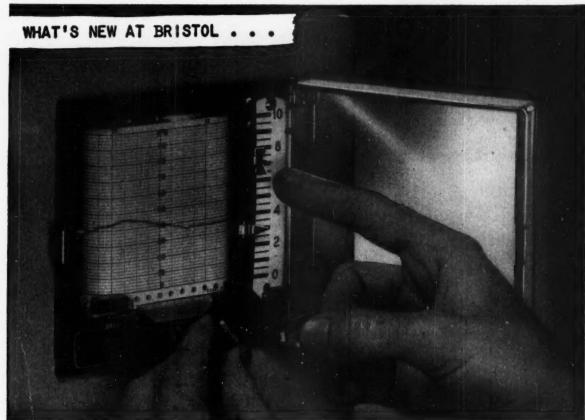
Kaiser Chemicals

calcined and hydrated aluminas

Alumina • Basic Refractory Bricks and Ramming Materials

Dolomite • Magnesia • Magnesite • Periclase

December 1954—CHEMICAL ENGINEERING



BRISTOL'S "HUMAN-ENGINEERED" METAGRAPHIC RECORDER, with its easy-toread scale, high-visibility fluorescent pointers and shadow-proof door has earned the distinction of being the "biggest little instrument in the business."

Instrument men call Bristol's METAGRAPHIC Recorder "... the biggest little instrument"

Sounds contradictory, but it's true. Take a look at one of our new METAGRAPHICS mounted on a panel board alongside of other instruments. The Bristol unit stands out — seems bigger than the rest — although chances are it's actually smaller (5" x 5%"). The answer is that the Bristol instruments have been "human-engineered", making them easy to read, and clearly visible at greater distances.

The air-operated METAGRAPHIC, which records pressure, temperature, vacuum, flow, differential pressure, and liquid level, offers these big advantages:

SIMPLICITY . . . fewer moving parts, fewer adjustments, and less service required. Range changes can be made in seconds. True plug-in service.

CONTINUOUS VALVE-POSITION INDICATION . . . on same instrument scale as set-point scale, gives continuous data on control valve position—makes "bumpless" transfer possible simply by matching pointer positions — no need to read actual scale values — minimizes reading errors — speeds operations.

CONTINUOUS OPERATION . . . complete unit can be retracted for inking pen, and for set-point and zero adjustment without disturbing record or control.

Get the whole story on the "human-engineered" METAGRAPHICS — how they can help you get more accurate measurements, faster and easier. Write us today. The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

BRISTOL

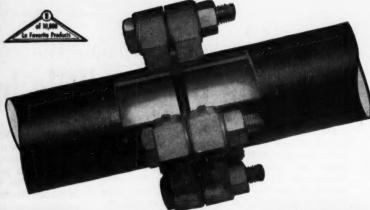
POINTS THE WAY IN
HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

CHEMICAL ENGINEERING—December 1954







A Leak-proof Joint in 2 MINUTES!

Apply split flange and gasket, bring pipe ends together, tighten nuts on bolts.

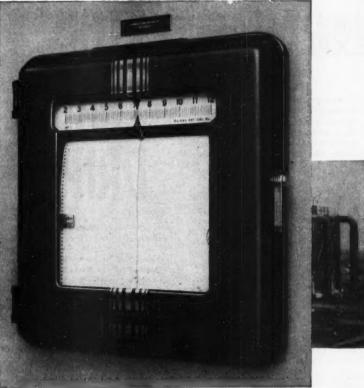
TWO MINUTES is all the time that it takes using the FIELDLINK method of joining rubber lined pipe in both new and existing lines. It is a simple, easy and economical method for reducing a major expense in chemical processing—the maintenance of rubber lined fluid conducting lines.

For details, send for Bulletin 2958

269 Wagaraw Road • Hawthorne, N. J.

Here is the panel-mounted Speedomax instrument which records and controls pH of cooling water in the towers at KG&E's Murray Gill Station. The actual record shows pH being controlled within ±0.1pH.





pH is no problem

IN THIS COOLING TOWER

The once troublesome problem of effectively controlling the pH of cooling tower water has been solved in the towers at the Murray Gill and Ripley Stations of Kansas Gas and Electric Company.

Various other control arrangements, on similar tower systems, have been tried . . . with varying degrees of success. But the present system at KG&E demonstrates that, with the application of L&N's Controllability Analysis and practical engineering principles, a cooling tower system can work for, rather than against, full-function control of pH.

The benefits of effective pH control are readily apparent at KG&E. According to a report from the company's Production Department, they include "conserving large amounts of make-up water, wood protection, prevention of carbonate scale, and more effective slime control." The report adds that "automatic pH control at both plants has been effective and satisfactory."

We'll be glad to discuss your cooling tower pH control questions with you. Write for Process Data Sheet 700(1) which explains "L&N pH Control of Cooling Tower Water." With it, you'll receive a Controllability Analysis Questionnaire which will help us to analyze the controllability factors of your towers. Fill out the Questionnaire and return it, without obligation, to Leeds & Northrup Co., 4916 Stenton Ave., Philadelphia 44, Pa.



AN EXPLANATION

In answer to increased interest in a recently inaugurated procedure for conducting "on-the-spot" demonstrations of air-flotation equipment, we are pleased to make the following explanation.

The advent of our lab-size Whippet V-80 Separator makes it possible to establish, in your own plant and at your convenience, accurate forecasts of results which will be obtained from the identical process under full-scale operating conditions.

Such a demonstration may be of invaluable aid to that phase of your research program which involves the economy of operations and the quality of raw or end products. Perhaps the V-80 will indicate an immediate usefulness. Seeing is believing.

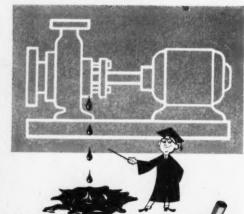
Your move is simple. Write to the department and address below. Tell us that you want to see the results of separations made by effecting differences in specific gravity through air-flotation... under your actual operating conditions, rather than in a catalog. We'll take it from there.



DEPT. C-1254

SUTTON, STEELE & STEELE, INC.

STOP THAT DRIP!



Pump stuffing box drip is a thing of the past when you install Sealot-Flexibox Mechanical Shaft Seals. In hundreds of leading plants throughout the world, you'll find cleaner, safer, more efficient pumps operating without leakage, thanks to Sealot-Flexibox Seals.

Take this big step towards greater safety, economy, and reduced maintenance. Write today for data and recommendations on mechanical shaft seals for your pumps . . . or send for Bulletin 9 giving complete details.

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IF YOU WILL GIVE US YOUR REQUIREMENTS AS TO TYPE, APPLICATION, LIFE, WEIGHT, WEAVE, POROSITY, TEMPERATURE AND ABRASION, WE WILL OFFER SUGGESTIONS.

Over 40 different weaves, filter twills and chaincloths, filter flannels etc. Cut and sewed for plate and frame presses. Sector filters, rotary filters in all sizes. Cotton, Nylon, Orlon, Dynel, Polyethylene, Dacron, Saran.

Synthetic fabrics for acid and alkaline solutions. Above fabrics furnished by the roll or cut and fabricated to meet your specifications for various applications. Write for samples.

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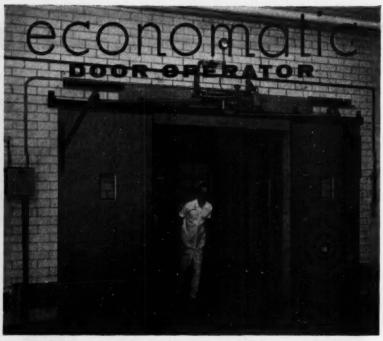
You get full 180° visibility . . . so you can read the liquid level from any point from which you can see the gage . . . with the New Convex Scale now available on Jergusor Truscale Remote Reading Gages. Scale markings are directly on the convex face and the indicator goes clear around the convex surface. You can stand at one end of the control room and instantly check your whole line up of Truscale Gages.

Jerguson Truscales give you instant remote readings of liquid levels of waste heat boilers, tanks, etc. . . . with the amazing accuracy of ½ of 1% of scale reading. And with the New Convex Scale you make these readings from any angle . . . accurately, without distortion. Truscales also available with lights, horns and Truscale Repeaters.

Write today for complete data on Truscale Gages with the New Convex Scale.



380



Opens The Door To New Savings in faster materials handling – improved temperature and humidity control

In the average plant, materials handling consumes up to 26% of production time! ECONOMATIC Automatic Door Operators cut this time drastically by giving traffic an uninterrupted flow . . . making manhours more productive.

ECONOMATIC also improves temperature and humidity control; reduces air conditioning and heating costs; shuts out dust, drafts, odors and noise; assures positive fire door protection and reduces expensive door damage.

ECONOMATIC also provides extra safety in plants where hazardous areas exist. It can be equipped with completely pneumatic controls and safety interlocks to ensure the "sealing-off" of adjacent departments.

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Get all the facts on how ECONOMATIC pays for itself in 2 to 3 months.

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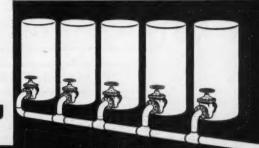
Please send me the facts on how ECONOMATIC saves money and manpower.

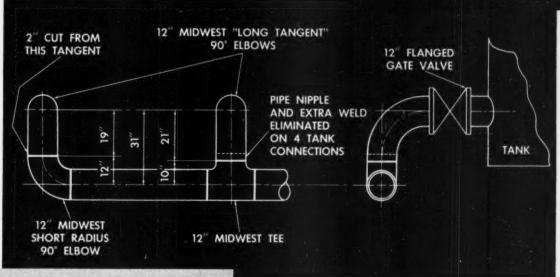
NAME COMPANY STREET ZONE STATE

MIDWEST "LONG TANGENT" ELBOWS

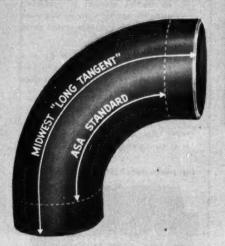
\$156²⁰

On This Welding Piping





MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS



The Problem:

To connect the five tanks shown in the sketch at top to a common 12" header.

The Difficulty:

The center-to-outlet dimension of the 4-12'' tees is only 10'', while the shortest elbow available measures 12'' center-to-end. Thus, if standard long radius elbows are used next to the five tank valves, four short nipples and four extra 12'' welds would be required.

The Solution:

By using Midwest "Long Tangent" elbows as shown in the blueprint, the expense of the four extra nipples and welds was eliminated at the cost of just one cut! The actual net savings made by "Long Tangent" elbows on this job was \$156.20.

Remember—Midwest "Long Tangent" elbows cost no more than regular elbows! For further information, write for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Missouri

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

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6820



WHY USE QUICK-COUPLING CONNECTORS FOR THERMOCOUPLE CIRCUITS 2

TO SAVE TIME!



Frequent making and breaking of thermocouple circuits can take a lot of costly time. However, if you use T-E plug-and-jack connectors, a circuit can be made as quickly and easily as plugging in a radio.

Electrical contact is established through polarized elements which are made of thermocouple materials (your choice for use with Iron Constantan, Copper Constantan or Chromel Alumel Thermocouples). To

maintain good electrical connection, the mated plug and jack provide both long-wiping surfaces and spring-loaded contacts. The connectors have screw-fastened, insulated covers, colored and marked to indicate calibrations.





PAT. PEND.

Interested? Write for Bulletin 23-E.



WHY USE CONNECTOR
PANELS FOR MULTIPLE
THERMOCOUPLE CIRCUITS?

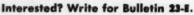


TO SAVE TIME!

By connecting all thermocouple circuits through central points, such as T-E's connector panels, you can save time in 2 ways.

(1) Check instruments or thermocouple circuits from one or more centrally located distribution panels. With plug-andiack connectors, test instrument is easily and quickly tapped into any circuit. (2) Transfer multiple thermocouple circuits. The panel's quick-coupling connectors permit rapid mak-

ing and breaking of instrument and 'couple circuits, eliminate splicing time and avoid mis-matching polarity. Panel illustrated takes 12 pyrometers, 36 thermocouples. Bigger or smaller panels, if you want 'em.



Pyrometers • Thermocouples • Protection Tubes • Quick-Coupling Connectors
Thermocouple and Extension Wires • Resistance Bulbs • Connector Panels

Thermo Electric Co., Inc.

SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY IN CANADA—THERMO ELECTRIC (Canada) Ltd., BRAMPTON, ONTARIO

HOW SUPERIOR SOLVES YOUR STEAM PROBLEMS



A COMPLETE PACKAGE

Completely factory-assembled and tested, a Superior Steam Generator is backed by undivided responsibility.

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...eliminates need of an expensive chimney... Multiple fans draw evenly on all tubes, reducing maintenance.

4-PASS, DOWN-DRAFT DESIGN

High gas velocities produce high efficiency. Down-draft design promotes rapid evaporation, quicker steaming.

AMPLE HEATING SURFACE

A minimum of 5 sq. ft. of heating surface per boiler horsepower assures maximum efficiency at full rated capacity.

RESERVE CAPACITY

Greater steam space and large evaporating surface provide ample reserve capacity & better than 99% dry steam.

NO EXPENSIVE FOUNDATION

Built on a rigid channel iron base, a Superior Steam Generator needs only a floor capable of supporting its weight.

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All controls essential to completely automatic operation are factory-wired into an easily accessible control panel.

BURN OIL, GAS, OR BOTH

Superior Burners burn oil or gas or a combination of both...changing from one fuel to the other in seconds.

18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for Catalog 622-F. Water Tube types up to 40,000 lbs./hour write for Catalog 622-W.

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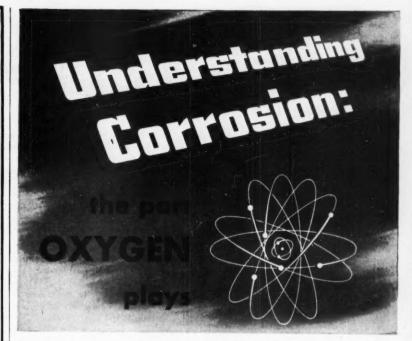
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Whether corrosion of metal occurs in moist atmosphere, under water, under ground, or in salt, alkali, or mineral acid solutions, the presence of oxygen is generally the controlling factor. The rate of corrosion depends mainly upon the concentration of available oxygen at the surface of the metal, but is influenced by such factors as temperature, pH, fluid velocity, viscosity, exposed surface area, pressure and humidity of the air, the depth to which the metal is immersed, and the presence of galvanic or other electrical actions.

In air, for example, the humidity becomes a determinant at about 35% and causes a marked increase in corrosion when it exceeds a critical point at 65%. If even minute quantities of corrosive gases are also present, the rate of attack on the metal is further accelerated. In liquid, the rate at which oxygen reaches a metal surface is governed by the velocity of the liquid. In a quiet system with velocity at a minimum, transfer of oxygen to metal is slow and by a diffusion process. Increased velocities increase the rate at which oxygen is brought in contact with the metal and, in turn, increases the rate of metal deterioration.

Getting at the root of corrosion's cause through understanding of the complex factors involved is a first step in control. Some of those factors can be eliminated or regulated. Helping metal get on with those that cannot has long been our specialized field of activity.

Dampney equipment-engineered protective coatings - vinyls, silicones, chlorinated rubber, ceramics, asphaltums - have provided a practical approach to many a difficult corrosion problem. Let us apply that experience to your particular corrosion control needs.



HYDE PARK, BOSTON 36, MASSACHUSETTS



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Tennessee's highest quality Sulphur Dioxide will do it better. Usually a more efficient and economical operation can be had through the use of this chemical (SO₂) with its varied and extended uses.

Let our technical staff show you how you might employ Tennessee's highest quality Sulphur Dioxide to greatest advantage.



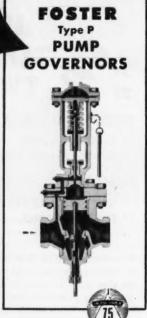
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Foster manufactures a complete line of self-contained, pilot-operated pump governors for controlling discharge pressure of reciprocating or turbine driven pumps in constant pressure, differential pressure, excess pressure or vacuum service. On motor driven pumps, Foster Relief valves are available in either constant or excess pressure type for installation in the discharge piping.

These valves have wide, easily adjusted pressure ranges, and like all Foster valves, are designed and built for long life with a minimum of maintenance and are easy to service when necessary. Ask for Bulletin P-101.



FOSTER ENGINEERING COMPANY

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AUTOMATIC VALVES .

SAFETY VALVES

FLOW TUBES

Use DENVER SAMPLERS

- for correct process control

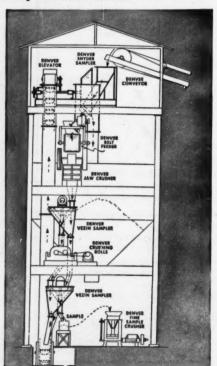
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OUTMODES ALL OTHERS

for Throttling Control Service

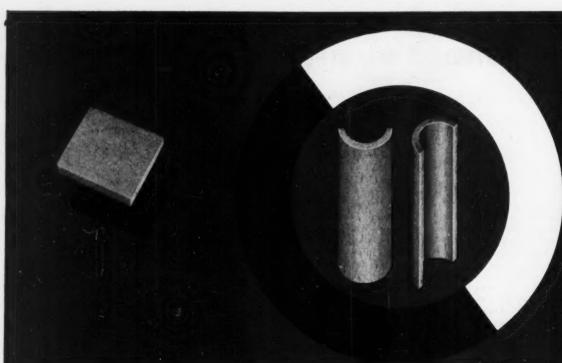
... CONOMOTOR

Conoflow is unbiased in evaluating the relative merits of the Cylinder Conomotor over spring-and-diaphragm and springless diaphragm motors. Conoflow makes all three. But look at the chart below . . . There's not merely an "edge", but a wide margin of superiority in the Cylinder Conomotor . . . in weight . . . in compact size . . .

in speed of operation . . . stem travel . . . and thrust. No other operator surpasses it for positioning accuracy and stability of operation. Diaphragm breakage is eliminated and maintenance is greatly reduced. It's easy to convince yourself. Just try one or several . . . and you'll standardize right down the line on Conomotor Series LB Control Valves.

(COMPLETE DETAILS IN CATALOG LB-1)

B-10-TM ring & Diaphragm Motor	B-12-T Springless Diaphragm Motor	B-53 Cylinder Consensore
4	– 50 square inches –	
750 lbs.	1250 lbs.	4500 lbs.
12 seconds	10 seconds	
1"	13/8"	
30 psi	30 psi	
45 lbs.	45 lbs.	
11¾" dia. 16¾" height	11½" dia. 14¾" height	of dis. 14' herebit or es
	ring & Diaphragm Motor 750 lbs. 12 seconds 1" 30 psi 45 lbs. 1134" dia.	Motor



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PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY

DECEMBER 1954

Interchangeable **Bundles for Three Condenser Units**

Three condensers recently completed in the Kellogg shops for a major refiner represent an optimum interchange-ability of bundles—a feature every refiner wants but one that is often difficult to achieve in a unit without

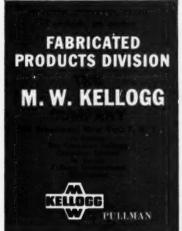
over-engineering it.

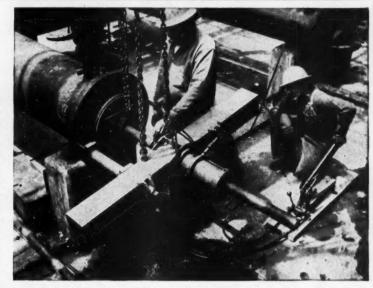
The three condenser units, designed to handle C-4 cuts, comprise a total of 14 shells. Following normal design practices, initial Kellogg engineering proposals included three sizes of shells. However, further study by Kellogg engineers proved, in this instance, that it would be most economical in the long run to design the entire group of 14 shells for interchangeable bundles. Both proposals were submitted, the customer agreeing that the interchangeable bundle plan best served their purposes.

Each of the 14 sections are of floating tube sheet construction with 2040 square feet of 3/4-inch admiralty tubes, naval brass tube sheets, and steel baffles. Inside diameter of each shell

is 33 inches.

Interchangeable bundles for this many sections will offer several important advantages to the refiner. They will, for example, cut down considerably on refinery maintenance stock, since only one spare bundle need be kept in stock to service any one of the 14 sections. Shorter down-time for repairs are also expected to result from the fact that the spare bundle can be substituted easily in an emergency without shutting the unit down for lengthy repairs or rebuilding.





Portable Bundle Puller Saves Time Eliminates Costly Rigging

Shown here in use at a major Eastern refinery is Kellogg's special device, known as the Hydro-ejector, for removing and inserting heat exchanger bundles.

The device, portable and easily operated by two men, reduces down-time and eliminates the need for "jerrybuilt" rigging often required to pull even the smallest tube bundles. From the standpoint of time, experience has shown that it takes less than 25 minutes for the device to push a tube bundle out eight feet.

And even the largest bundles will not stick when pushed by the force of 12,000 pounds that may be exerted by the Hydro-ejector. The device is attached directly to the bonnet-end shell flange of the exchanger. It does not pull a bundle; it pushes it.

The Hydro-ejector is safer to useparticularly in the case of overhead exchangers-because workmen do not have to clamber out on the bundle after it is partly pulled to attach hoists. Ropes for lowering the bundle are

attached as it is ejected and ride along with the unit from a trolley on the hoisting beam.

The Hydro-ejector will fit any size exchanger. Although now available for use in existing refineries, the unit was originally designed for customary types of exchangers in new processing plants as a means of reducing investment for supporting steel work. In cases where more than one Hydro-ejector is used, all parts including the jack and pumping unit are interchangeable. The only auxiliary equipment are two hoists, suspended at the channel end of the exchanger, to handle the tube bundle as it is ejected or replaced.

In operation, two men may work it with ease. One is required to pump the jack while the other keeps an eye on the bundle to ensure alignment.

Each unit consists of a hydraulic center-hole jack, supported by a fabricated steel base which is bolted directly to the exchanger. It is self-contained and portable, the heaviest piece of equipment being less than 75 pounds.

Send for New Booklet On Kellogg Exchangers

A new booklet which describes in detail the types of tubular heat transfer equipment available from Kellogg has just been com-pleted. It not only shows examples of a variety of heat exchangers, coolers, condensers, reboilers and other process equipment, but also covers in some detail the expanded facilities available at Kellogg since the shops were modified for production-line manufacture of heat transfer units.























Here's aluminum Chloride

in the RIGHT SIZE for your use

Most often, a particular process using aluminum chloride, anhydrous, works best with a selected particle size.

We have taken technical liberties in this picture (exposing aluminum chloride to the air) to show you the four sizes available from Hooker.

Extra work of screening isn't necessary when you specify Hooker aluminum chloride. The four sizes give you a choice that will meet just about every process requirement:

1. Extra fine grind is unscreened, with

90 to 95% passing 40 mesh.

- 2. Fine grind is unscreened, practically all passing 20 mesh.
- 3. Coarse grind is unscreened, 1 mesh and finer. It contains 25 to 35% finer than 20 mesh.
- 4. Coarse screened is the same as coarse grind (No.3), but is screened to remove 20 mesh and finer.

Before re-ordering your requirements, get the facts on Hooker aluminum chloride. For technical data, just phone the nearest Hooker office listed below, or mail the coupon today.

Need other chlorides? This is only one of several metal chlorides available from Hooker. Chlorinated organics and inorganics are specialties with us; we've been making them for more than 30 years. If you need a special chlorine-containing compound in quantity, we may be able to produce it for you economically. To find out quickly, just phone the nearest Hooker office or write us today.

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5 Forty-seventh St., Niagara Falls, N. Y.

Please send:

- Data sheet on Hooker aluminum chloride, anhydrous
- ☐ Bulletin 100 describing Hooker products and services

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- From the Salt of the Earth -

HOOKER ELECTROCHEMICAL COMPANY

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SCRUBBING CORROSIVE GASES?



Fig. 645

Are your scrubbing nozzles as efficient as you think they could be? Do they resist the corrosion or wear conditions satisfactorily — produce the breakup and distribution you would like?

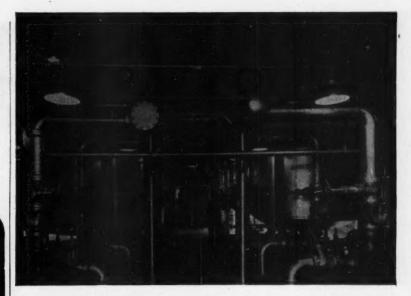
Outline your spray problem for us—if your liquid can be sprayed with direct pressure at all—Monarch can furnish the nozzles.

NOZZLES FOR:

- . OIL ATOMIZING
- HUMIDIFYING
- . AIR WASHING
- . DESUPERHEATING
- . SPRAY PONDS
- . MILK POWDERING
- . ACID CHAMBERS
- . CONCRETE CURING

Write for Catalogs 6-A and 6-C

MONARCH MFG. WKS., INC. 2517 E. ONTARIO ST. PHILADELPHIA 34, PA.



Higher purity water from Cochrane DEMINERALIZERS

For make-up or process, Cochrane Demineralizers deliver a continuous supply of demineralized, silica-free water at remarkably low cost.

Cochrane offers demineralizer designs to meet the most stringent requirements—
2-bed, 3-bed, 4-bed or compact mixed bed units manually or automatically controlled. Effluent produced is of a higher electrolyte purity than most distilled waters yet normally costs many times less.

Cochrane engineers and manufactures every type of ion exchange and precipitation type water conditioning equipment which assures you of unbiased recommendations for equipment best suited to your requirements. Its complete service provides single responsibility for engineering, fabrication and continued satisfactory operation.

For further details on Cochrane Demineralizers, write for Pub. 5800.



Mixed bed unit designed for automatic operation. Delivers an effluent with less electrolyte than is possible through any other method.



Cochrane

CORPORATION

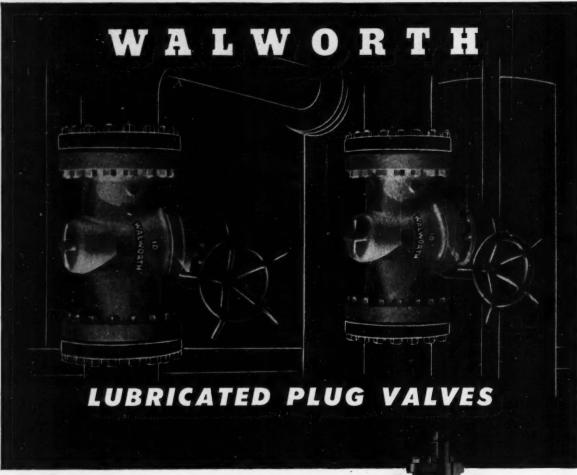
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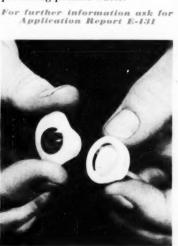
DECEMBER 1954

Insulator of KEL-F® Plastic Doubles as Vital Structural Part in Severe 250°F Water-Immersion Service

Perfect electrical insulation and maintenance of critical spacing of electrodes are provided by this spacer of KEL-F polymer plastic. Even under constant immersion in water at 250°F, insulation remains high, precision tolerances and dimensions of the spacer-insulator are

Excellent mechanical properties of this fluorocarbon plastic dielectric under extremes of temperature and stress permit the critical spacer to be used under heavy spring loading without deformation or failure. Accurately machined grooves in the plastic hold O rings to prevent liquid leakage.

McNab Incorporated, New York City, machines the spacers from rod extruded from unplasticized KEL-F polymer by the Resistoflex Corporation, Belleville, N. J. Spacers are used in special conductivity cell-valve units manufactured by the McNab company for use in marine and industrial installations producing potable water.





Prosthetic Eye Implants are Permanent— Non-Irritating to Living Tissue, They **Retain Shape Indefinitely**

periodic removal of prosthetic eye implants for replacement or "re-sizing" is the major advantage claimed for implants made from KEL-F polymer plastic. Once "fitted" to the individual eye socket, the implant retains its original size and shape, does not shrink or swell to cause pain to the wearer. The plastic's heat and moisture resis-

tance allow it to be steam sterilized.

Since the fluorocarbon plastic is chemically inert, it does not cause irritation to adjacent sensitive tissues.

The plastic implant, known as the "Allen", is custom made from KEL-F polymer Grade 270 by Precision-Cosmet Co., Inc. of Minneapolis, Minn.

For further information ask for Application Report P-103

(SEE REVERSE SIDE)

KELF TRIFLUORO ETHYLENE POLYMERS KELF MOLDING POWDERS KELF FLUORO CARBON PLASTIC KELF DISPERSION COATINGS KELF TRIFLUORO ETHYLENE POLYMERS

KELF

DILS WAXES GREASES

KEL-F Polymer Teamed With High-Alloy Steel in New Centrifugal Pump For Corrosives, Sanitary Use

A KEL-F plastic O ring is used with Type 20 stainless steel and heat-resistant glass to create a new, low-cost centrifugal pump with extreme corrosion resistance and ready flow visibility.

The KEL-F plastic seal remains resilient, is unaffected by practically all known chemical agents over a wide range of temperatures and prevents damage to the glass cover plate. Unique physical characteristics of the plastic permit ready dismantling of pump and re-use of the O ring without loss of sealing effectiveness.

The new pumps, built by the Eco Engineering Company, Newark, N. J., use precision O rings molded of plasticized KEL-F polymer Grade 300 P-25 by Young Development Laboratories, Inc., custom molders of Rocky Hill, N.J.

For further information ask for Application Report C-121



Recent Significant KEL-F Polymer Developments...

Lip seals for liquid oxygen and other liquefied gas equipment operating at low temperatures are molded now of KEL-F plastic. Resiliency at subzero temperatures, dimensional sta-bility and chemical inertness overcome shortcomings of other gasket and sealing materials used.

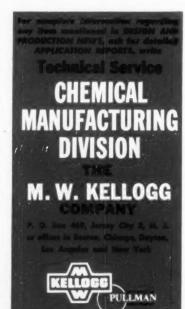
Liquid level gauges now have their glasses protected by a thin sheet of KEL-F plastic. Remaining transparent in-definitely in spite of contact with highly corrosive chemicals such as HF, the plastic sheets act as their own gaskets.

Miniature coil forms are molded of KEL-F plastic for use in electronic devices operating at elevated temperatures. Types include special models with metal inserts.

Quality test for use by the manufacturer of trifluorochloroethylene polymer parts (the "Z.S.T." test) has been developed and field-tested by Kellogg. Test is simple, requires no special training. Equipment is automatic, eliminates the human error factor in test results.

OFF THE PRESS ... Revised" BUYERS GUIDE" listing KEL-F polymer products, molders and fabri-

cators.



Leading molders, extruders and fabri-cators specialize in the production of mate-rials and ports made of 'Kel.F". Red-month this column will spotlight several of these companies with their principal services and products.

Auburn Button Works, Inc.

Auburn, N. Y.

Injection molding

Bacon Industries, Inc. Watertown, Mass.

Compression & transfer molding Gaskets & O rings

Elco Corporation

Philadelphia, Pa.

Injection molding Electronic tube sockets

Electronic Mechanics Inc.

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Woodbridge, N. J.

Corrosion control Dispersion application

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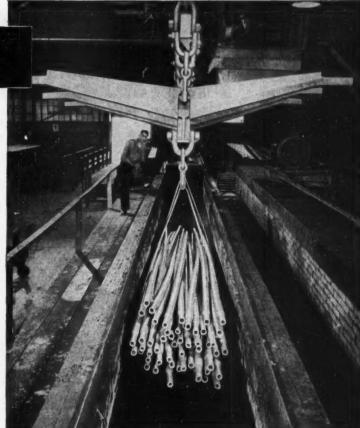
KELF

Industry wipes out corrosion with Firestone Exon Resins

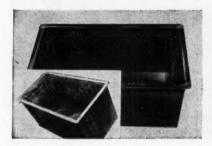
LINED WITH VYFLEX L-10*

TANKS WIN EVERY BATTLE AGAINST CORROSION

Corrosion costs kept pyramiding at the Globe Steel Tubes Co., Milwaukee, Wisconsin. At temperatures of 80° to 90°, solutions of 20% nitric acid-hydrofluoric acid quickly ruined each type of costly lining tried in the 47-foot "pickling tank." After exhaustive tests of every available material, Globe engineers finally hit upon Vyflex L-10* made from Exon 900 series resins. This durable vinyl lining ended their corrosion problem. Installation was quick, simple and less costly than the linings previously used. Subsequent maintenance and replacement costs have been eliminated!

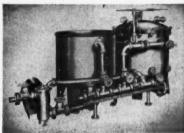


Installation by National Acid Proofing Co., Tinley Park. Ill.



★ Corrosive chromic acid plating solutions destroyed in 6 months protective surface applied at the Tripp Plating Co., Buffalo. At 150° operating temperature, the acid has yet to affect tanks since they were lined with Vyflex L-10°.

Sestaliation by Metal Cladding Inc., Bulfalo, N.Y.



★ Standard 4200 G.P.H. chrome plating solution filter with Vyflex L-10* linings, made by Industrial Filter & Pump Mfg. Co., of Chicago. This leading filter manufacturer selected Vyflex L-10* linings as part of the original construction for this unit.



★ At Hoffmann-LaRoche Plant in Nutley, N. J., Vyflex L-10's* versatility permitted on the spot relining, without dismantling the huge 6'x6'x10' bleach tanks. Thus, installation costs and "down" time were greatly reduced.

Installation by La Favorite Linings, Inc., Hawthorne, N.J.



The simple fact is: you can stop corrosion. The tank liners shown above are based on only one of the many Exon resins developed by Firestone engineers to answer corrosion problems.

Exon polyvinyl chloride resins are the bases for a wide variety of corrosion controlling materials. In the form of lightweight structural rigids, linings or coatings, these versatile P.V.C. materials have a wide range of properties, providing the answer to your specific corrosion problem.

For details that will interest you in particular, call or write:

Chemical Sales Division

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NOTE: Firestone supplies the resin only, does not manufacture the end product.

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport

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How Surface Films Affect Condenser Tube Corrosion Rate

The nature and distribution of surface films formed on condenser and heat exchanger tube surfaces has a tremendous influence on the rate of corrosion. These films may be formed in two ways: (a) by deposit of waterborne materials which may either protect the metal or accelerate corrosion; (b) as the result of a chemical reaction which forms a corrosion film. These films may or may not protect the metal.

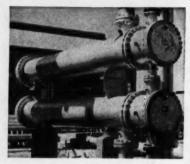
The films which form on metals may vary in thickness, color, chemical composition, smoothness, physical properties and permeability to water.

Protective Films

Some of these films measure about 1/10,000,000 of an inch in thickness but may give considerable protection against corrosion.

During their early stages of formation, these films may be sensitive to injury from abrasion, impingement or changing water conditions. This initial sensitivity explains the rapid attack sometimes evident in newly installed tubes. Tubes that are given a chance to develop a uniform, adherent film are frequently able to resist progressively more severe corrosive conditions without serious effect.

The various condenser tube alloys available show great differences in their ability to rebuild their protective film and in the speed with which they do so. Rapid healing of broken films is an outstanding characteristic of Bridgeport Argenical Aluminum Brass, Duronze IV (arsenical aluminum bronze) and 70-30 Cupro Nickel. This is a direct result of the low rate of solubility of the alloy and/or its film. This film strength explains why these alloys withstand impingement corrosion so successfully. However, if the water contains corrosive agents which destroy the film, the corrosion resisting properties of the metal are greatly reduced. The difference in ability to rebuild a protective film should be considered by



operators getting unsatisfactory service life from tube alloys. This is influenced by the type of tube, water velocity, composition of the water, etc.

Nonprotective Films

Those surface films which are non-protective usually are insoluble in the corroding medium, and have the following characteristics: 1) They are permeable to water (they permit the passage of fluid through them). 2) They are sufficiently dense to impede the flow of fresh corrosive solution to the metal surface and the movement of corrosion products away from the metal surface. 3) They are nonuniform or discontinuous, thus permitting the corrosive solution to come in contact with metal in certain areas while partially screening the metal in others.

This may lead to the following phe-

under the thicker pornomena: 1) Corrosion may be increased in certain screened areas by the formation of corrosion cells. 2) The metal tions of partially permeable film may become pitted (anodic area) or locally corroded. 3) The exposed metal or those areas covered with thinner films are only slightly corroded (cathodic area). 4) The continued accumulation of corrosion products in

the screened areas often accelerates the formation of deeper pits or enlarged areas of corrosion.

The properties of these nonprotective films or deposits aid in the formation of the corrosion cell (metal ion and oxygen) types of corrosion. The corrosion cell begins to operate when the corroding substance is present in different concentrations at adjacent areas on the metal surface (see diagram).

The localizing of the corrosion is due to the fact that differences in electrical potential exist between the various parts of the metal surface where localized corrosion is taking place. The corrosion is largely electrolytic.

There are available a number of mechanical and chemical means of dislodging or dissolving some of the corrosion products or deposits from condenser tubes. Some of the undesirable types of film should be removed from tubes at suitable periodic intervals before corrosion is initiated.

Bridgeport Technical Service

Bridgeport's Technical Service and Corrosion Laboratories have spent many years studying condenser and heat exchanger tube corrosion. Their knowledge and experience are available to help you solve your corrosion problems and to select the best alloy for your operating conditions. Your nearest Bridgeport Sales Office will be happy to put this service to work for you. Call it for more information and for your copy of Bridgeport's informative Condenser and Heat Exchanger Tube Handbook.

WATER SOLUTION $H_2O \rightleftharpoons H^+ + OH^-$ PIT (ANODE)
CONTAINING SOME
CORROSION PRODUCT
THIN FILM (CATHODE)

METAL TUBE WALL

ANODIC REACTION $M \rightarrow M^+ + 2 \ e \ \frac{1}{2} \ O_2 + H_2O + 2e \Rightarrow 2 \ OH^ M^+ + 2 \ OH^- \Rightarrow M \ (OH)_2$

How localised pitting occurs under corrosion product or deposit by electrolytic reactions.





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P-4246, Chemical Engineering 330 W. 42 St. New York 36, N. Y

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P. 4406 Chemical Engineering.

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- Devine Vacuum Shelf Dryer No. 12; shelves 40" x 42".
- Squier Stainless Clad Rotary Atmospheric Dryer; 30" x 20'.
- Horsey S.S. Rotary Gas Fired Dryer; 5' x 26'.
- Bagley & Sewell Double Drum Dryer; 28" x 60" with Accessories.
- C.E. Two Stage S.S. Flash Drying System; 1000 lbs. evap. per hour. Louisville Steam Tube Dryer; 54" x 40' with Cooler 38" x 20'.
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 1—National 10''x20'' two-roll Mill, 25 HP
- Premier Colloid Mills 8" dia., S.S.

 -Premier Colloid Mills 8" dia., S.S.
 -Jeffrey 30"x24" Hammer Mill, Type A.
 Raymond, Gayco Separators 12", 8", 6".

 -Rietz 12" Disintegrator with 20 HP
- motor -Mikro Pulverizers, #2TH, #1SH, #1SI

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MIXERS

- 2-Banbury #9, #3A.
- 4—Baker Perkins 300, 100, 50 and 1 gal. sigma blades, jacketed, steel and S.S.
- Baker Perkins 50 gal. JEM, 50 HP.
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- l-Readco 1 gallon, S.S. Vacuum.
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- 10-Nash Pumps TS12, TS8, H8, H7, L3 MD571, #4, #2,
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3-roll Day 5 x 12, 12 x 32, 16 x 46".

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Colloid: Premier 3" s. st., 7½ hp.

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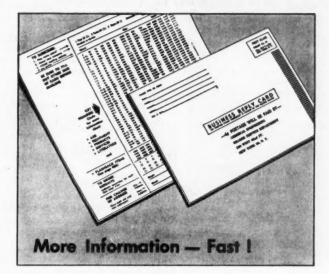
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You can get more information on any product listed in this directory by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, then mail to us. Answers will come to you direct from the companies manufacturing the products.

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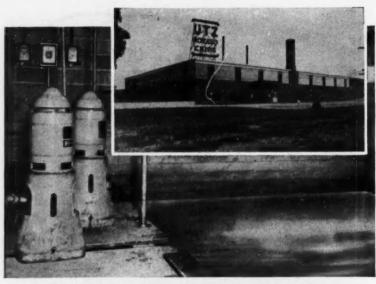
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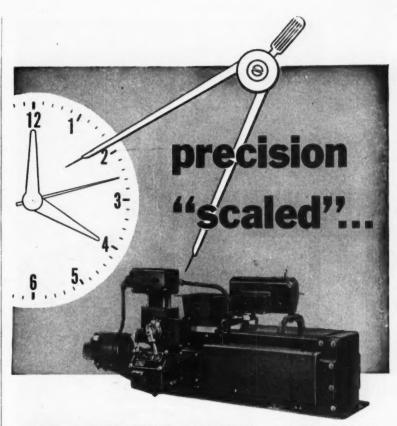
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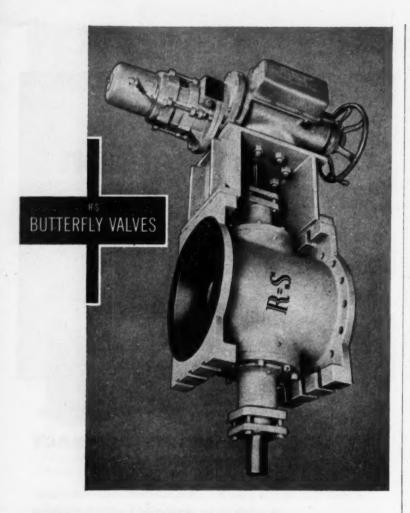
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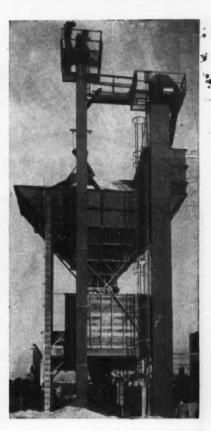
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Flashback.

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The index below repeats the editorial listings only on chemicals, equipment and services featured last month in New Equipment and New Products. Use the postcard (p. 449) for more information on any items.

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Welding electrodes

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What It Contains

This is a comprehensive listing of the latest literature you can now get from manufacturers on chemicals, equipment and services in all fields of interest to chemical engineers. It lists new publications just issued as well as all bulletins mentioned in this issue. For your convenience, all items have been categorized and alphabetized.

For More Information . . .

You can get—and get fast—more information on any publication listed in this guide by using the Reader Service post-card inside the back cover. Simply circle the item's code number on the postcard, fill in your name and address, then mail to us. Ask for as many as you need. Answers come to you direct from the companies putting out the literature.

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Contents of This Issue . . .

Guide to Technical Literature

Want to build up your files and keep them up-to-date? This comprehensive guide to available literature will help you do just that. They're yours—free—for the asking.

Chemicals

- Acetone.....Colorless, highly flammable liquid...a powerful solvent for cellulose acetate. Physical properties, Celanese specifications, shipping & handling, toxicology, etc. in Bulletin No. P-20-139-1-3-54.

 418A Harwick Standard Chem. Co.
- Acetone.....High specification material
 —over 99.5% pure. Its purity, uniformity & constant supply are assured
 because it is produced synthetically.
 Wide range of solvent uses in booklet,
 "Ketones."—No. F-4767.
 418B Carbide & Carbon Chem.
- Acid, Ascorbic.....The antiscorbutic vitamin...antioxidant in food industry ...reduces smoking time, improves cure color, retards fading in cooked & cured meat products, etc. Technical Information Sheets. 418C Mallinckrodt Chem. Wks.
- Acid. Azelaic..... Economic replacement for high-priced dibasic acids has unlimited potential use in plasticizors, alkyd resins, polyesters, polyamides & synthetic lubricants. Sample & descriptive literature available. 418D Emery Industries.
- Acid, Benzene Phosphinic.....Suggested uses general anti-oxidant; to improve film properties of cured polysiloxane resins; intermediate for forming metallic salts; etc. Makes available a product sample.

 418E Victor Chem. Wks.
- Acid. Chromic......Informative literature includes a complete technical description, acid properties, principal uses, composition, data on packing, shipping regulations, etc. Request Bulletin No. 06-22-2-3-54.

 418F Harwick Standard Chem. Co.
- Acid, Formic.....Points the way to better quality in many products—possesses a combination of properties which make it the preferred acid for industrial applications. Offers detailed Technical Bulletin.

 4186 Heyden Chem. Corp.
- Acid, Hydrexyacetic..... A proven organic acid for numerous industrial applications. Provides complete description specifications, chemical and physical properties, suggested uses, bibliography, etc.—on request.

 418H E. I. du Pont de Nemours.
- Acid, Phosphoric..... Chemical of a thousand uses... AA Quality phosphoric acid, in its various grades, amply & consistently meets national formulary & pure food specifications. Data Sheet offers full details. 4181 American Agricultural Chem.
- Acid, Thiomalic.....Features important potential in resins, plasticizers & rubber. Contains physical properties, chemical properties, suggested uses, & a basic bibliography of literature references, in Bulletin 1-9.

 1163

 National Aniline Div.

- Acid. Undecylenic.....A high degree of chemical reactivity is assured thru structural features rarely found in fatty acids, such as an odd number of carbon atoms & vinyl unsaturation. Property Sheet & Search Report. 418K Baker Castor Oil Co.
- Additives.....Provides data on Lubricin N-1—company's low cost additive. Offers valuable uses as: crank case oil additive; motor fuel additive; cutting oil additive. Includes sample with Technical Bulletin 16.

 418L Baker Castor Oil Co.
- Alcohols, Fatty.....New company line of higher fatty alcohols and fatty alcohols suifates feature excellent qualities—superior detergency, stability, emolliency, and emulsification. Provides product samples.

 418M Stepan Chem. Co.
- Alicyclic Compounds.....Derivatives of cyclopentane—cyclohexane. Offers important data on cyclopentanone, cyclopentanone oxime, cyclopentanone oxime, cyclopentyl chloride, cyclohexene, cyclohexyl chloride, etc.

 418N

 Arapahoe Chem.
- Amines, Tertiary-Alkyl Primary.....

 New 40 p. booklet covers line of tertiary-alkyl primary amines. Includes physical & chemical properties, suggested applications, chemical reactions, etc. Bulletin No. SP-33.

 4180 Rohm & Haas Co.
- p-Aminophenol Technical Product can help you . . . in the preparation of pharmaceuticals, dyes, anti-oxidants, photographic chemicals, oil additives, Offers complete data about this remarkable intermediate, 418P E. L. du Pont de Nemours.
- Ammonia, Cylinder.....Company presents valuable handbook, "Guide to Use of Barrett Brand Cylinder Armonia." Shows most economical usage—as well as containing chemical properties, handlind charts, etc.

 33a Allied Chem. & Dye Corp.
- Ammonia Leak Detector Kits.....Now offered upon request by manufacturer—a useful ammonia leak detector kit. These handy kits are conveniently pocket size, and can be put to use over and over again.

 53b Allied Chem. & Dye Corp.
- Ammonium Biborate.....Covers theoretical composition, solubility in water, pH values, representative chemical analysis, typical screen analysis, containers, density & uses. Technical Bulletin No. 8.

 418Q Pacific Coast Borax Co.
- Antioxidants.....Newly developed antioxidant—Ionol-CP—defends fats & oils against oxidative spoilage. A convenient, safe & inexpensive way to combat rancidity in food & drugs. Sample & information on usage. 418R Shell Chem. Corp.
- Anti-Static Agents.....Announces an outstanding anti-static agent—Cationic SP. Small amounts effectively control static charge accumulation on wide variety of materials. Offers samples & technical information.

 4185 American Cyanamid Co.

1

Benzel.....Technical Bulletin 109-53,
"Benzel Toluol Xylol," contains numerous photographs and descriptions of Texas plant & offers specifications on company line of aromatics. Available on request.

418T Cosden Petroleum Corp.

- Butyl Carbitel Acetate Solvent for numerous types of coating resins. Provides valuable information con-cerning physical properties, specifica-tions, shipping, applications, etc. Technical Bulletin F-8844. 419A Carbide & Carbon Chem.
- Butyl Oleate Technical.....Butyl oleate is a primary plasticizer & solvent for natural & synthetic rubbers, & ethyl cellulose. Covers specifications, prop-erties, solubility, etc. in Bulletin No. 07-20-02-54. 419B Harwick Standard Chem. Co.

Carbon, Activated.....Discusses the properties and uses of activated carbon in purification, air recovery, other in carbon recovery, chemical catalysis, and separation processes. Includes schematic drawings. Form 27.

4190 Barnebey-Cheney Co.

Casein.....Illustrated, 12 p. furnishes pertinent information on casein—a thorough description, making casein (details "old" and "new" ways of producing casein), various grades, etc. Bulletin No. P-19-70-04-54. 419D Harwick Standard Chem. Co.

Catalysts, Platinum Metals.....In many procedures, production control, purity of end product & cost of catalysis are brought to peak efficiency thru use of one of the platinum metals catalysts. Uses & forms.

Baker & Co.

Chemicals, Fatty......40 p. Catalog offers data on all standard ADM fatty chemicals: hydrogenated glycerides, hydrogenated fatty acids, saturated & unsaturated fatty alcohols, sperm oils, & sperm oil products. 419E Archer-Daniels-Midland Co.

Chemicals, Research.....Company announces the availability of a new Folder. This convenient reference describes 45 Victor research chemicals. Some of these interesting chemicals may offer possibilities to you.

419F Victor Chem. Wks.

Chemicals, Textile.....14 p. Booklet designed to furnish review of some of company's newer developments in textile chemicals — anti-static agents, chemicals for dyeing, surface-active chemicals, etc. No. F-8679A.

419G Carbide & Carbon Chem.

Cleaners, Industrial Presents de-scriptive literature covering Petro-clean D-25 . . a new concentrated, emulsifying-type, industrial liquid cleaner for the purging of fat, oli and grease, Request 4 p. booklet. 419H Whisticlean Corp.

Cyanoethylated Cotton, Dyeing Company makes available an 18 p. fully illustrated booklet entitled, "A Preliminary Study of the Dyeing of Cyanoethylated Cotton." Dyestuff Technical Bulletin No. 837.

4191 American Cyanamid Co.

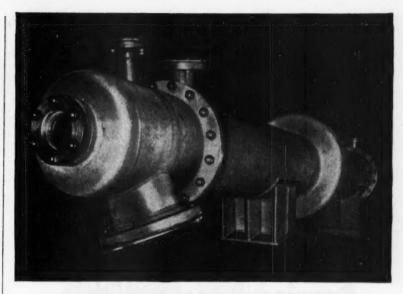
Dichloroacetaldehyde Literature includes complete description, typical analysis, properties, toxicity, suggested uses, stability, availability, etc. For details refer to Technical Data Sheet No. S-7. Westvaco Chem. Div. Westvaco Chem. Div.

2,6-Dilsopropylphenel.....Covers o-Alkyl phenols—valuable new raw materials for the synthesis of synthetic resins ... plasticizers ... surface-active agents. Technical information (Fact Sheet) & product sample.

419K Ethyl Corp.

Dispersing Agents.....Daxad dispersing agents put a negative charge on individual particles in aqueous media. The particles repel each other—you get a stable dispersion. Complete data on Daxads in new Brochure.

419L Dewey & Almy Chem. Co.



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6"	37	30	28	31	24	20	14	14	12
8"	68	66	60	55	48	40	31	26	24
10"	110	106	96	8.5	76	72	42	40	36
12"	170	156	148	126	118	104	64	64	60
14"	212	196	188	151	148	140	85	82	72
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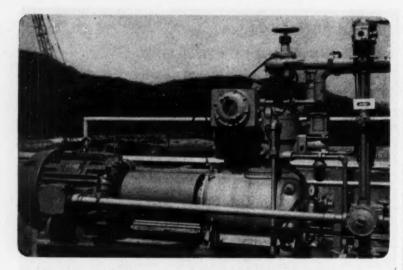
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Below: Frick compressor transferring ammonia at the Frisco (Texas) Fertilizer Co.



LITERATURE . . .

- Ethanolamines Mono-, di-, and triethanolamines — products of high purity and high quality—will soon be available in tank cars, tank trucks and drums. Offers technical literature on important company line. 420A Allied Chem. & Dye Co.
- Fluids, Hydraulic.....20 p., fully illustrated booklet presents valuable information concerning Skydrol fire-resistant aircraft hydraulic fluid. Discusses in detail the advantages, properties & conversion costs.

 420B Monsanto Chem. Co.
- Formaldehyde.....With its characteristic high quality...formaldehyde meets the specifications of a wide variety of industrial users. For data on company's line request their informative product Booklet.

 429C Allied Chem. & Dye Co.
- Formaldehyde.....Features 4 specialized types—Formalin, Paraformaldehyde, Formeel, Trioxane—designed to meet specific needs. The right one can give you the competitive edge. Offers details on product line. 420D Celanese Corp. of America
- Giycerine.....Valuable booklet offered by producer — "Glycerine — Preferred for Product Conditioning" — outlines properties that make glycerine preferable in conditioning tollet goods & pharmaceuticals, etc. 166 Glycerine Producers' Assoc.
- Grignard Reagents.....8 p. Folder covers
 pertinent information regarding;
 properties; uses; standardization;
 recommended handling procedure;
 shipping regulations; custom manufacture via the Grignard reaction.
 420E Arapahoe Special Products
- Hydrogen Peroxide.....20 p., profusely illustrated reference supplies data on the bleaching of wool raw stock, yarns, fabrics...with "Albone" hydrogen peroxide. Also covers safe handling, packaging and storage.

 420F E. I. du Pont de Nemours.
- Insect Toxicants.....Company's new, 28
 p. Technical Booklet is a compilation
 of information on the properties &
 uses of insect toxicant—Thanite.
 Formulations & application results
 given for various uses.
 4296 Hercules Powder Co.
- Insecticides.....Formulation suggestions for many of the newer pesticides as well as the established ones are provided in addition to other useful emulsification data. Request Technical Hulletin No. 42.

 Emulsol Corp.
- Lithium Borohydride.....Offers technical information on lithium borohydride. Features valuable uses: organic reducing agent; hydrogenation agent; hydrogen generation; etc. Find complete details in Bulletin 402. 4201
- Magnesia Compounds.....From pharmaceuticals to fertilizers & building board to rubber...magnesia compounds serve industry as fillers, extenders, adsorptive & conditioning agents, etc. Catalog & details.

 420J Michigan Chem. Corp.
- Magnesium Stearate Purified A fine, white powder; odorless. Uses—a covering agent, a dry lubricant, bodying agent, gel-breaker and emulsifier. Descriptive Technical Information Sheet is made available.

 420K Mallinckrodt Chem. Wks.
- Methyl Cellosolve Acetate.....Excellent solvent for cellulose acetate & other cellulose esters. Includes physical properties, shipping data, general solvent properties, specifications, etc. in Technical Sheet F-8623. 420L Carbide & Carbon Chem.

1

Methyl Glucoside.....Check the numerous advantages for methyl glucoside....the new polyol...to keep performance up—to keep cost down. Company furnishes upon request samples and descriptive technical literature.

420M Corn Products Refining Co.

Miticides..... Presents an informative Folder concerning the application of Aratron to destroy heavy infestations of spider mites on crops. Outstanding feature is its immediate and effective killing powers. Eston Chem. Div.

Morpholine.....Bulletin provides useful data on physical & chemical properties, uses & potential applications & presents vapor pressure, specific gravity, viscosity, surface tension, & other curves. 48 P.

421B Jefferson Chem. Co.

Nadie Anhydride.....12 p. booklet summarizes physical properties, chemical reactions & suggested uses of 3,6-endomethylene- A*-tetrahydrophthalic anhydride. Includes 68 literature references. Bulletin 1-5.
4210 National Aniline Div.

Nitroparaffins...... 6 p. Folder covers de-scription and industrial applications of nitroparaffins. Includes nitro-methane, nitroethane, 1-nitropropane, 2-nitropropane, 2-amino-2-methyl-1-propanel, etc. propanol, etc.

421D Commercial Solvents Corp.

Octylphenol & Nonylphenol.....Provides a descriptive, 16 p. Booklet covering company's line of octylphenol and nonylphenol. Includes physical prop-erties, uses, chemical reactions and an extensive bibliography.

421E Rohm & Haas Co.

Industrial.....Detailed specifica-tions, shipping data & suggested usage on products of animal, vegetable & marine sources including: oleic acids, red oils, stearle acids, glycerines, etc. 8 p. Bulletin.

Swift & Co.

Olis, Wool.....Company furnishes upon request a descriptive booklet entitled, "Twitchell 7421 Oli," covering their anti-static fiber lubricant for use in processing woolens, worsteds, and blends. 421G Emery Industries.

1,5-Pentanediol..... Makes available useful literature and information on this promising new chemical. Forms esters and polyesters which may find use as plasticizers, emulsifying agents and resin ingredients. resin ingredients.
421H E. I. du Pont de Nemours.

Phosphites.....Valuable data on dibutyl, dioctyl, tributyl & trihexyl phosphites. These neutral compounds are colorless liquids with mild, pleasant odor & good thermal stability. Provides Brochures & samples.

4211 Virginia-Carolina Chem.

Polystyrene, Expandable.....24 p. describes a new foamable polystyrene. Applications in various industrial fields are discussed. Includes technical data with charts and diagrams in color. Bulletin No. C-4-204.

421K

Polyvinyi Materials......12 p. illustrated Booklet describes Geon polyvinyl ma-terials...for industrial and consumer uses. Covers the forms available, their properties, and suggestions for their use. 421L B. F. Goodrich Chem. Co.

Polyvinylpyrrolidone.....Pure versatile polymer for industry. Offers unique combination of properties & a wide range of applications. Technical data on this high pressure acetylene de-rivative, samples, prices, etc. 421M General Aniline & Film.

Potassium Borohydride.....White micro-crystalline powder—soluble in water, alcohols, liquid ammonia. Non-hygro-scopic. Stable in air. Decomposes in vacuum at 500°C. Completely descrip-tive literature on request. 421N Metal Hydrides.



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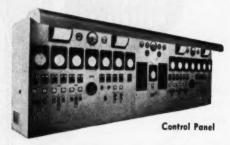
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LITERATURE . . .

- Pyrrole.....An extremely reactive compound, offering interesting possibilities as a chemical intermediate. It reacts by substitution, condensation, splitting of the ring and reduction. Full information.

 422A E. I. du Pont de Nemours.
- Resins......Epon resin coatings based on the XA-200 formulation . . . find outstanding success in the chemical process industries. Brochure covers full Epon coatings story—"Planning to Paint a Pyramid?"

 Shell Chem. Corp.
- Resins.....28 p. offers latest data on compounding plastisols with Geon Resin 121. Covers plastisol flow properties, preparation & fusion of plastisols, plastisol applications, etc. Illustrated Bulletin PR-3. 422B B. F. Goodrich Chem. Co.
- Resins.....Provides valuable information on line of phenolic, vinyl, styrene resins for coatings in descriptive booklet, "Bakelite Resin Coatings for the Chemical Industry." Data on numerous applications.

 219 Bakelite Co.
- Resins.....Use the unique properties of Piccolastic resins...to improve your products. Makes available samples and a Bulletin furnishing complete information regarding the various grades of these resins.

 422C Pennsylvania Industrial.
- Resins, Industrial For new developments in industrial resins & varnishes, plastics compounds, silicones, electrical insulating materials, plastics laminating & molding, etc. request new Booklet No. CDG-101.

 422D General Elec. Co.
- Resins, Phenol-Formaldehyde Offers data on Gen-Tac resin . . . a watersoluble, phenol-formaldehyde resin for use in dip preparations to obtain adhesion between rubber & fabric. Bulletin No. 12-171-1-1-154. 422E Harwick Standard Chem. Co.
- Resins, Vinyl Dispersion.....Data on application technique for low-cost plastisol coatings on wire goods, paper, fabric, foll, and electrical assemblies made available in new, 36 p. Technical Release No. 14. 422F
- Sequestering Agents.....Powerful organic sequestrants are setting new standards in chelating iron...calclum ...magnesium. Company's latest revised literature explains testing methods and comparisons. 422G Refined Products Corp.
- Sodium Borehydride.....Features numerous uses: organic reductions; foaming agent; hydrogen generation; hydrogenation; etc. For technical information regarding sodium borohydride request Bulletin 502. 422H Metal Hydrides.
- Sodium, Metallie.....Supplied in tank cars, in steel drums (bricks or solid cast) or small brick in 20 lb. palls. Employed as molten liquid, as bricks, as dispersion in an inert hydrocarbon, etc. Offers Booklets.

 4221

 U. S. Industrial Chem. Co.
- Sodium Stearate Purified Powder.....A fine, white powder; slight fatty acid odor. Thickening & wetting agent for creams, shampoos & water base ointments; detergent for dentifrices; etc. Technical Information Sheet. 4224 Mallinckrodt Chem. Wks.
- Solvenis..... Produces complete line of aromatic solvents for insecticides, printing inks, synthetic enamels, resins, varnishes, adhesives, for thinning surface coatings. Catalog and specifications upon request.

 422K Eastern States Chem. Corp.

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Sorbitol.....Possesses a combination of qualities that make it particularly suitable as a softener or moisture stabilizing agent in a wide variety of products. Presents free sample & informative technical literature. 422L Atlas Powder Co. - Want more information on any of these items? Just circle its code number on the postcard inside the back cover, then mail to us. It's that easy now.

Stearates, Metallic..... Because of their fineness, metallic soaps, or stearates, mixed into paints, penetrate the finest pores in masonry. They form films that water cannot wet. Detailed literature available.

423A American Cyanamid Co.

Sulphur Dioxide...... A versatile chemical reagent for industry, sulfur dioxide can be used as a reducing or bleaching agent, preservative, antichior, neutralizer, pH control. Details in "Virginia SO₂" Folder.

44 Virginia Smelting Co.

Tricresyl Phosphates.....For perma-nence and non-flammability—in com-bination with any plastic resin. Offers technical literature and information regarding advantages to be had by using different types of Kronitex. 423B Ohio-Apex Div.

Triethanolamine.....Offers one of the widest ranges of uses for emulsions & other chemical processing fields. 44 p. booklet, "Allphatic Nitrogen Compounds," covers physical properties, specifications, etc.

4230 Carbide & Carbon Chem.

Trimethylolethane.....New polyol for short oil alkyds. TME alkyds excel in: soap and alkali resistance; reten-tion of color and gloss; heat stability; durability; etc. Supplies samples and Technical Bulletin. 428D Heyden Chem. Corp.

Trischloroethyl Phosphite Technical
Data Sheet S-15 covers description,
typical analysis, properties, uses
(known & potential), typical reactions, as well as handling precaution,
toxicity & availability,
423E Westvaco Chem. Div.

Urea, Crystal.....Purity and uniformity make it ideal for use in a large number of products and processes. Offers complete information—specifications, chemical and physical properties, suggested uses, etc. ted uses, etc. F E. I. du Pont de Nemours.

Vitamin Bis.....A dark red, crystalline powder; practically odorless & taste-less. Uses—as anti-anemia factor in treatment of pernicious anemia, trop-ical & non-tropical sprue, etc. Tech-nical Information Sheet. 423G Mallinckrodt Chem. Wks.

Vitamin E.....Compiles bibliography about vitamin E in chicken nutrition. Covers such items as sources of vitamin E in poultry feeds, the chicken requirements and the symptoms of vitamin E deficiency, etc.

423H Distillation Products Ind.

Wax, Petroleum.....Data on Polymekon
—newest and most revolutionary development ... a specially processed
petroleum wax (not a blend). Makes
available samples, technical informaiton, specifications, etc.
4231

Warwick Wax Co.

Zireonium.....Numerous important uses
—acid-resistant materials, corrosionresistant materials, electronic getter,
scavenger, etc. Furnishes pertinent
technical data on company product
line in Bulletin 700.

423J Metal Hydrides.

Zirconium Zirconium Technical Information Survey designed to introduce this material and some of its outstanding properties. Sections include: general corrosion information; approximate strength; etc.

423K

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LITERATURE . . .

Construction Materials

Adhesives.....Company furnishes a new, valuable booklet describing typical starting formulations, properties, and methods of application of "Thiokol" liquid polymer/liquid epoxy resin ad-hesives. 16 p. 424A Thiokol Chem. Corp. Thiokol Chem. Corp.

Adhesives, Lagging 20 p. covers data on lagging adhesives, sealers, surface coatings, fire retardant mastics and vapor barriers. Includes full technical product information. Reference Manual No. 545.

Benjamin Foster Co.

Adhesives, Laminating.....Announces the availability upon request of a new, three-color, profusely illustrated manual on laminating adhesives . . . for film, foil, fabric and other web laminates. 12 p. Manual No. 110. 4240 Rubber & Asbestos Corp.

Adhesives, Pressure Sensitive.....Pressure sensitive adhesives—normally used in form of adhesive tapes—have recently attained considerable industrial importance. Full details in Bulletin No. P-12-62-1-5-54.

424D Hardwick Standard Chem. Co.

Alloys.....Iliustrated, 24 p. describes
Super Alloys—high strength heat &
corrosion resistant materials. Used
for critical parts of jet engines &
other forms of gas turbines, turbosuperchargers, rockets, etc.
424E Universal-Cyclops Steel.

Alloys, Hardsurfacing.....Describes the chemical and physical properties of alloys...furnished either in form of hard surfacing weld rods, or in cast forms, made to the customers' specifications. Illustrated, 4 p.

424F

Coast Metals.

Cements, Sulfar.....Acid-proof cements of "melt & pour" type—used for bond-ing acid-proof brick or tile & for seal-ing joints of bell-&-spigot pipe. Appli-cation, benefits, specifications, etc. Data Sheet CP-584a. 424G Pennsylvania Salt Mfg. Co.

Coatings, Protective.....Illustrated Bulletin provides data on durable & protective baked-on phenolic resin coatings... for steel & other metals. Includes full description, applications, features, etc. 8 p. Lithcote Corn Lithcote Corp.

Coatings, Protective.....Offer valuable features—one coat stops rust ... dries in 10-20 minutes. Paint Selection Check Chart enables you to pick right paint for each maintenance painting job. Request your copy.

4241

Wilbur & Williams Co.

Coatings, Protective.... Describes "Alo-dine" No. 1200—the ACP metal-pro-tective process that enhances alumi-num's natural corrosion-resistance num's natural corrosion-resistance and vastly improves its paint-bonding properties. 4 p. Folder. 424J American Chem. Paint Co.

Centings, Protective..... Gives complete information on base formulation ... adhesion ... abrasion resistance ... chemical characteristics ... film thickness & cost. Find details in new 8 p. Brochure No. 150.

330 Celicote Co.

Costings, Protective.....Presents an il-lustrated discussion of the various types of asphaltic mastic protective coatings available for use on masonry, brick and concrete sidewalls, roofs, etc. 4 p. Pamphlet. 424K Emjay Maintenance Engrs.

Coatings, Protective.....Quick, easy, clean, low-cost way to get lasting coal tar protection against corrosion... in handy tape form. Full details of advantages, application, economy, etc. Illustrated, 8 p.

424L Tapecoat Co.

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- Coatings, Protective.....Pennpaint 20 developed to meet industry's need for a corrosion-resistant coating of wide usefulness. Includes application, advantages, specifications, etc., in Data Sheet CP-587.

 425A Pennsylvania Salt Mfg. Co.
- Fabrication, Process Equipment.....
 Fabrication of vessels, agitators or precision machinery...to engineering, design & construction of process units or entire industrial chemical plants. Offers Bulletins.

 136 Industrial Process Engrs.
- Insulation, Pipe.....Presents a fully fllustrated Folder covering Vapo-Wall low temperature pipe insulation. Includes complete description, properties, advantages, installation, ordering information, etc. MMM, Inc. 425B MM, Inc.
- Lead Products.....For efficient control of corrosives. Provides all common mill shapes, sizes and forms...sheet, pipe, fittings, valves. Find complete details in new reference, "Chemical Lead Products."

 National Lead Co.
- Steels, Stainless.....Data on superior stainless steel sheets, strip, bars, plates, wire, forgings, etc. Details in informative booklet, "Making the Most of Stainless Steels in the Chemical Process Industries."

 154 Crucible Steel Co.
- Tungsten.....20 p. Brochure describes manufacture, properties and uses of tungsten. Colorful flow-chart shows how tungsten is manufactured and quality-controlled from ore to finished products. Illustrated. 4250 Sylvania Elec. Products.

Electrical & Mechanical

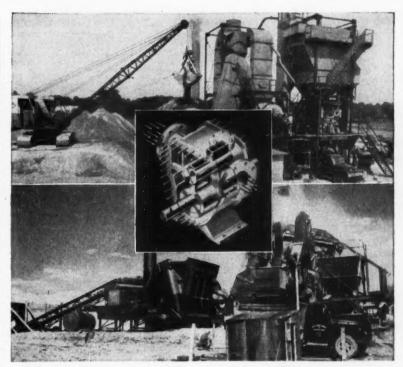
- Belts, V-.....New Manual covers V-belts of all designs including standard, super, steel, notched steel, openend, detachable-link, and double-V construction. Also drive design data, selection tables, etc.

 425D T. B. Wood's Sons Co.
- Chains & Sprockets.....340 p., fully illustrated book includes valuable data on chains & sprockets for conveying, elevating & power transmission. Features flexible cover & handy thumb index. Catalog No. 950, 426E Link-Belt Co.
- Chains & Sprockets.....Announces publication of a new Catalog on the company line of miniature mechanical chain and sprockets, with complete engineering data and accessory information. Fully illustrated, 8 p.

 425F Sierra Engrg. Co.
- Drives, Poly-V.....New concept of power transmission. Features include: solution to "matching" problems; reduced belt & sheave inventory with greater interchangeability, longer life; etc. Illustrated Brochure 6638.

 4250 Raybestos-Manhattan.
- Drives. Shaft-Mounted.....These versatile speed-reducing units save space, power, material, and time. Includes selection, application, and dimension details in new, completely illustrated, 8 p. Bulletin 7101.

 Falk Corp.
- Expanders, Tube.....Describes company's line of tube expanders for condensers and heat exchangers, and furnishes complete details on how to choose the proper expander for each rolling job. Illustrated Bulletin Y-38, 425I
- Motor Starters.....Throughout petroleum industry, EC&M motor starters are providing continuous safe service ... helping to boost petroleum production. Describes 2200-5000-volt motor starters in Booklet 1062. 425J Electric Controller & Mfg.



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These asphalt mixing plants are protected against plant shut-down by Kinney Model SD Pumps . . . the positive displacement pumps of maximum durability.

Kinney Model SD Pump's rotary piston mechanism is completely free of vanes, springs, valves, and obstructions. The SD Pump has oversized, jacketed openings for suction and discharge, permitting free pumping of asphalt at lower temperatures. Because of this pump, each of these asphalt mixing plants functions smoothly and uninterruptedly . . . virtually without necessity for pump maintenance or service. The Kinney Pump's high volumetric efficiency insures accurate proportioning of asphalt into the mix. This pump also serves as transfer pump during loading and unloading periods.

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- Moters.....Explains the advantages of pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers. Find complete details in Builetin B-2201.

 62 Reliance Elec. & Engrg. Co.
- Meters, Gear.....Feature new dependability, greater starting torque and top efficiency, with output speeds as low as 7.5 rpm. Find complete information on gear motor line in descriptive Bulletin No. GM-1. 257 Howell Elec. Motors Co.
- Meters, Worm Gear.....Covers worm gear motors for horizontal or vertical drive—with a ratio range from 5.65:1 to 100:1 and from 36 to 30 hp. Rating tables, prices, dimensions, etc. Catalog No. 46-C. 426A D. O. James Gear Mfg. Co.
- Packings & Gaskets..... Especially designed for chemical and process equipment. These various Chempac materials—which withstand virtually all chemicals—are made of asbestos treated with teflon. Illustrated.

 426B

 Johns-Manville.
- Power Transmission, Mechanical

 Covers line of mechanical power transmission products—silent chain, roller chain & Hy-Vo drives; sprockets, cable chains, drive shafts, coulings & clutches. Catalog B20-53, 426C
- Reducers, Motor.....Data on gear motor reducers...horizontal or vertical drive—35 sizes, ratio range 10:1 to 1200:1 & from % to 75 hp. Rating tables, dimensions, prices, etc. included in Catalog No. 47-C.
 426D D. O. James Gear Mfg. Co.
- Biags, O-..... For general industrial hydraulic fluids as well as water & air service..., are precision-moided of Buna N fuel & oil-resistant compounds. Find details in Industrial O-Ring Folder. Illustrated, 4 p. 426E Stillman Rubber Co.
- Selectors, Packing, Presents valuable Simplified Packing Selector—a cardboard disc six Inches in diameter which helps select the right (most economical) packing for almost any application in seconds. 426F N. Y. Belting & Packing.

Handling & Packaging

- Bag Clesing Machines.....New illustrated booklet entitled, "Suspended Head Bag Closing Machines," describes a simple and popular line of machines capable of handling a wide range of work. Bulletin 201.

 426G Union Special Mach. Co.
- Belt Cleaners, Conveyer.....S-A spring type conveyor belt cleaners . . . designed to remove material adhering to belt after discharge, thus insuring maximum belt life by preventing cover wear. 4 p. Bulletin 651. 426H Stephens-Adamson Mfg. Co.
- Belts, Conveyer.....Company presents a new color chart containing valuable engineering information — indicates strength characteristics of eight popular conveyor belt constructions. Charts available upon request. 4261 Quaker Rubber Corp. Div.

- Boards, Deck.....New series of magnesium dock boards incorporates numerous advances in design and engineering. Easily handled by one man ...can be built to handle loads up to 20,000 pounds. Descriptive Builetin. 426J Magline, Inc.
- Chlorine Handling.....Illustrated 26 p.
 Brochure on safe handling of chlorine.
 Includes details on methods of shipment; instructions for handling,
 storage from, care, and return of containers, etc.
 Columbia-Southern Chem.
- Conveyors.....Illustrated, 32 p. covers company's three featured, patented products and custom built conveyor equipment. Includes features, typical applications, operation, engineering data, etc. Catalog 370.

 Prab Conveyors
- Conveyors.....40 p. furnishes information on gravity conveyors (roller and wheel types), power conveyors (live roller and belt types), etc. Includes applications and construction features. Catalog No. 54. 426M
- Cenveyers.....Covers conveyors of all types, bucket elevators & feeders.

 32 p. on troughing idler conveyors, pulleys, idlers, takeups, & other parts; full range of flight conveyors; etc. Illustrated Catalog 54.

 426N Bonded Scale & Mach. Co.
- Docks, Loading.....Eliminate need for permanent loading docks, truck wells or elevators. A highly portable unit ...it features a capacity of 6000 pounds. Describes many advantages in fully illustrated Bulletin. 4260 Raymond Corp.
- Magnets.....Describes the line of electric and non-electric magnets for installation in, on or above material conveying systems and integration with processing machinery. Full de tails in Catalog C-5000-B. 301 Dings Magnetic Separator.
- Materials Handling, Bulk-Fle..... Equipment designed to reduce handling costs on wide range of materials. Features ability to feed, convey, elevate in one compact, fully enclosed assembly. 28 p. Book 2475.

 13 Link-Belt Co.
- Ramps, Dock..... New illustrated Cataiog Sheet details 10,000-lb.-capacity manual floating hydraulic adjustable dock ramp. Includes photos and engineering drawing, operating and design features, specifications. 426P Rowe Methods.
- Scales, Filling..... Especially built for production weighing of granular, flake, pellet or fibrous materials. Covers details on features, performance and specifications for Models 1900G and 1900N. Illustrated. 426Q Thayer Scale & Engrg.
- Separators. Magnetic..... Presents new, fully illustrated booklet covering line of non-electric permanent magnetic separators...for removal of tramp iron. Includes data on Magnalarm. 16 p. Catalog No. 17.

 426R Eriez Mfg. Co.
- Separators, Magnetic..... New series of gravity flow & pneumatic hump nonelectric permanent magnetic separators...offers more protection from tramp iron hazards in pipe & chute conveyor lines. Bulletin 275-A. 4268 Magnetic Engrg. & Mfg. Co.
- Trucks, Pallet.....The moving and storing of numerous types of multi-unit loads by company's line of pallet hand lift trucks, fully described and pictured in new colorful literature. Request 12 p. Brochure P-673B. 426T Yale & Towne Mfg. Co.
- Weight-Control Systems.....Announces a new remote weight-control system ...for continuously & accurately blending additives with process material. Features & advantages covered in Technical Reference 54D. 426U Richardson Scale Co.

Heating & Cooling

- Baffles, Boiler.....Illustrated 20 p. offers latest data on modern boiler baffles & how they are designed for the streamlined flow of the gas of combustion over the heat-absorbing surfaces. Bulletin No. BW-54.

 426V
- Diffusers, Steam.....Illustrated Bulletin describes the new V-Groove steam diffuser... for introducing steam directly into the water for open-tank heating. Silent—no vibration—uniform heat distribution. 426W O'Brien Steam Specialty.
- Heat Exchangers......Compact, highly efficient and rugged source of high pressure hot air or gas. Pressures to 300 psig, temperatures to 1200°F. Applications, operation, construction, etc. in Bulletin 105.

 426X Thermal Research & Engrg.
- Heaters.....Announces release of 20 p. illustrated catalog describing all models of fuel oil heaters, with detailed information as to dimensions and capacities. Includes valuable selection data. Bulletin 743.

 426 Y Manning & Lewis Engrg. Co.
- Heaters, Electric.....New electric heaters make use of copper-sheathed, mineral insulated, resistance cable. Presents background, application & performance characteristics, in fully illustrated Bulletin 1603.

 426Z Nelson Elec. Mfg. Co.
- Heaters, Electric....Mineral insulated heating unit is a copper-sheathed heating element of rugged construction...safe & easily applied. for wide range of uses. Full details in illustrated, 8 p. Bulletin.

 426AA Continental Elec. Equipment
- Heaters, Electric.....Specially built internal heaters used in air dryers to provide accurately controlled heat essential to top performance. Many other electric heaters, applications, etc. in Catalog CE-54.

 425BB Heatube Corp.
- Heaters, Storage.....47 p. fully illustrated reference covers valuable data on hot water storage heaters—capacities & weights, dimensions, conversion tables, construction details, etc. Catalog No. 18.

 42600 Patterson-Kelly Co.
- Heaters, Unit.....Describes new series of horizontal unit heaters...designed to provide comfortable outlet temperatures on high pressure, high temperature steam systems. Complete details in Bulletin 700-A5.

 426DD American Air Filter Co.
- Heating & Air Conditioning..... Manufacturing engineers of heating, air conditioning, ventilating and heat transfer equipment... announce the availability of their illustrated Product Bulletin No. PB-290.

 426EE Trane Co.
- Heating-Ventilating Units..... Capacities range from 1,200 cfm to 15,000 cfm—can provide heating, ventilation, filtering, humidifying, or any combination of these functions. Bulletin offers complete information.

 425FF American Air Filter Co.
- Platecells..... Designed for tank heating and cooling problems due to inefficient pipe coils. These cost-saving Platecoils heat or cool 50% faster and take 50% less space in the tank. Bulletin No. P61. Tranter Mfg.

1

Scoops, Syphon..... Company announces the release of new literature which explains the fundamental principles of the new Armstrong "Syphon Scoop" for draining cylinder dryers. Illustrated, 4 p. Bulletin 266, 426GG Armstrong Mach. Wks.

- Towers, Cooling.....Illustrated, 36 p. provides a description of induced-draft cooling tower construction. Covers advantages of "Counterflo" design, methods of water distribution, etc. Bulletin CT-ID-0.002.

 427A Fluor Corp.
- Towers, Cooling.....New 20 p. booklet,
 "Test Your Tower," describes simple
 direct method by which purchaser of
 industrial cooling tower can assure
 himself that he will receive performance exactly as specified.
 427B Marley Co.

Instruments & Controls

- Analysers, Gas.....New supersensitive gas detector makes possible accurate detection of toxic or combustible gases in extremely low concentrations. Covers operation, specifications, models, etc. in Bulletin 501.

 Taller & Cooper.
- Annunciators Literature available concerning all modern forms of lamp annunciators, including back-lighted message plates, sealed & non-sealed relays, standard & custom designs. New Catalog Bulletin 854.

 427B H. R. Kirkland Co.
- Colorimeters......Explains theory & use of new additive-colorimeter designed to serve as permanent "color memory" for control chemists in paint, food, textile, paper, plastics, etc. industries. 8 p. Builetin FS-246.
 427E Fisher Scientific Co.
- Centrols, Packaged Boiler.....Valuable information on the fully automatic, all electric metering type packaged control...for water tube type packaged boilers. Includes schematic diagram. Builetin 53-1088-239.

 427F Hays Corp.
- Dynamometers..... Lists all company products (dynamometers, testers, mechanical pressure gages, etc.) together with illustrations & specifications of each model. Aslo wide variety of accessories. Bulletin 19-F.
 4276 W. C. Dillon & Co.
- Gages, Boller Water.....Pertinent information on high pressure boiler water gages with separated-design flat glass inserts. Offer superior quality and workmanship, and dependable service. Bulletin No. WG-1812. 427H Yarnall-Waring Co.
- Gages, Tube.....New tube gage provides a quick, simple way to accurately measure inside tube diameters prior to rolling small tubes in condensers and heat exchangers. Gage measures to .001". Data in Bulletin Y-39.

 4271 Elliott Co.
- Gaging Equipment, Tank.....Illustrated, 80 p. provides valuable information covering all types of gaging equipment, from top reading hand gages to the latest pulse code telemetering system. Bulletin No. CP-3007.

 427J Vapor Recovery Systems Co.
- Indicators, Capacitive Level.....Meterindicating level monitor deriving its signal from an inert capacitive-type sensing probe fully described in new leaflet. Covers features & specifications, Form No. LI-2. 427K Thermo Instruments Co.
- Indicators, Liquid Level.....Describes remote liquid level indicators with new raised wide-vision face. Every part is precision-machined—every agsembled instrument is precision-tested. Bulletin No. WG-1824.

 427L Yarnall-Waring Co.
- Indicators, Self-Balancing.....Instruments for rapid reading, or logging, many temperatures quickly and accurately, Describes both types—potentiometer pyrometer and resistance thermometer. Bulletin 61.

 427M Thermo Elec. Co.



for heavy abrasive slurries with solids in suspension

Where abrasive wear is unusually severe or could cause severe damage if the casing wore out, a Lawrence Lined Slurry Pump provides the answer.

The pump is built with a casing liner, disc liner and impeller made of hard, brittle, abrasion-resistant alloy such as manganese steel, Ni-hard, etc. As the casing is designed to withstand full pressure, the liner can be used until actually worn out. Renewal of both the liner and the impeller (if necessary) is very simple because the casing is split horizontally.

The impeller is made with extra large clearances to prevent clogging. Sealing connections are provided on the suction disc and on the hub to

flush out any grit or solid matter to prevent wear at these points.

For complete information about Lawrence Slurry and Sludge Pumps write for Bulletin 207-4.





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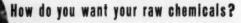
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LUMPY CHEMICALS?

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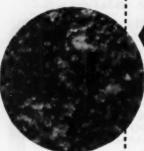
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When crystalline or powdered chemicals become caked or agglomerated due to atmospheric conditions or pack down in shipment, it is necessary to restore them to their original form without grinding the crystals to dust. A Prater power screener is ideal for smoothing out such materials because its action is gentle enough to cause no grinding or attrition which would destroy the crystalline structure.





Full size crystals practically free of floury dust and ready for mechanical mixing or solution.



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LITERATURE . . .

- Measuring Units, Light.....Illustrated bulletin provides technical details and specifications of the Colorede computing flicker photometer with Brown Electronik instrumentation. Data Sheet No. 10.10-5.

 428A Minneapolis-Honeywell.
- Metallographs......Presents 6 p. illustrated Folder which contains a feature-by-feature description of the new Reichert Research Metallograph "MeF", permitting all known methods of microscopic investigations.

 428B William J. Hacker & Co.
- Meters, Beta Ray H/C.....Provide a fast, accurate means of measuring the percentage of hydrogen, or the hydrogen-carbon ratio, in liquid hydrocarbons. For complete details on valuable instruments request Bulletin 115.

 428C Central Scientific Co.
- Recorders, Controllers & Telemetering Instruments.....New general bulletin lists and illustrates the complete line of recording, automatic controlling, and telemetering instruments. Bulletin DM035.

 Bristol Co.
- p. reference graphically describes a completely new line of pressure measuring elements... with greater operating power and improved accuracy. Request Bulletin No. 6-10.

 428E Foxboro Co.
- Rectifiers.....Announces the publication of a new, fully illustrated, 12 p. reference describing the complete line of selenium rectifiers for the electroplating & metal finishing industries. Catalog 441.

 American Rectifier Corp.
- Regulators, Automatic.....Furnishes completely illustrated Bulletin showing a selection of automatic regulators designed for use in the heating, power generating, and industrial processing fields. 4 p.

 4286 Atlas Valve Co.
- Regulators, Temperature.....Offer high continued performance...low continued cost. Features include: tight shut-off; rugged, field-replaceable thermostatic system; instantaneous response; etc. Bulletin ST.162B.

 428H Farris Stacon Corp.
- Tachometers, Vibrating Reed.....For portable use, or stationary mounting. Provide valuable features: simple to use; economical; durable; highly accurate; safe on highest species; etc. Illustrated Bulletin 770A.

 4281 Herman H. Sticht Co.
- Telephone Systems, Business.....Explains how a huge brewery makes use of a private internal telephone system in controlling quality and integrating complex stages of brewery operation. Illustrated Report No. 104. 428J Automatic Elec. Sales Corp.
- Transducers, Fluctuating-Pressure....

 Describes miniature flush-diaphragm strain-gage transducers. Offers dimensional & construction data in mechanical drawings & gives electrical circuitry. Form No. P7654.

 428K Electronic Engrg. Assoc.
- Viscometers.....23 p. reference. "Solutions to Sticky Problems," includes sections on: How the Brookfield Viscometer Works; A Simple Calibration Check; Making a Good Measurement; etc. Illustrated.

 428L Brookfield Engrg. Labs.

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Handles up to 6 bags per minute of unit weights ranging from 25 to 200 pounds. Also available as a net-weigher. Write for Bulletin 600G.

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New fully-automatic scale for weighing and discharging loads for bagging or batchweighing. Dry materials in granular or pellet form are readily handled by unique feeding system that closely controls amount and rate of feed of any free-flowing material without pre-aerating or separating. Once speed and weighing controls are set, operation is completely automatic.

Handles weight units from 23 to 200 pounds at speeds up to 10 units per minute. Stainless steel feeding system. Also available as gross-weigher. Write for Bulletin 400N.

Thayer Checkweight Scale Model 200R

Automatically indicates weight of filled bags, drums and cartons. Offweight packages are separated from those properly filled by having the motor-driven, two-way conveyor deposit them at opposite ends of scale. Over- and under-weight tolerances are

at opposite ends or scale. Over and under-weight tolerances are independently adjustable over a wide range.

Dial shows how much each package is offweight and horn sounds as each improperly filled package is discharged. Optional signal lights, remote dials, etc. available.

Model 200R handles up to 20 packages a minute with unit weights from 20 to 200 pounds. Write for Bulletin 200R.

Thayer Checkweight Scale Model 2005

This Thayer scale has same performance specifications as Model 200R but has the conveyor platform belt only 10" above the floor. With the conveyor located beneath the scale, the spillage from broken bags will fall to the floor and not affect the weight of the bags which follow.

Like the Model 200R, this scale may be equipped with additional distributions of the scale of

tional dial indicators for installation at remote control stations, colored lights which show whether the package on the conveyor is over- or under-weight, or a printing recorder which records the exact weight of each package. Write for Bulletin 2005.





it pays to be sure! Where weight is worth money .



Pipe, Fittings, Valves

- Connections, Pressure Vessel.....Com-prehensive reference data on complete line of pressure vessel connections, manways, necks, nozzles, etc. In-cluded are useful tables and specifica-tions. 70 p. Catalog 10-53. 430A Lenape Hydraulic Pressing.
- Connectors, Speed.....Manufacturer presents a new speed connector & automatic valve for gas, air, or liquid testing. Corrosion-resistant materials featured in construction. Find information in Catalog No. 354.

 430B Mechanical Products Corp.
- Couplings.....Offers industry a new & more efficient coupling having gear teeth which are cut on a segment of a sphere. Applied successfully in aircraft & other specialized fields. Request detailed Catalog C-540.

 430C Philadelphia Gear Wks.
- Fittings.....Offers Klinger Master Catalog describing the complete range of products... compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers.

 281a Klinger Corp. of America.
- Fittings, Welding.....Company's line of Key-Kast fittings are available in every shape, size, and schedule—in low and intermediate alloys and vari-ous stainless steels. Find complete details in new Bulletin.
- Pipe & Fittings, Giass......Glass pipe & fittings for full-scale production operations. Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Catalogs EA-1 & EA-3 offer full details.

 297a Corning Glass Wks.
- Pipe, Fittings & Valves.....For those operations which require the conveying of corrosive liquids. Feature valuable advantages of easy installation, added safety, no leakage, etc. Catalog details company line.

 Saran Lined Pipe Co.
- Pipe Installation, Glass.....Pipe is easy to install & low in installed cost com-pared with other corrosion-resistant materials. Available in 6 standard sizes from 1- to 6-inch. I. D. inclusive. Installation Manual. 297b Corning Glass Wks.
- Piping, Stainless Steel.....Informative literature outlines methods of bending and joining stainless pipe and discusses the problem of light wall versus heavy wall pipe. Copies of 6 p. Bulletin TB-356 on request.

 430E Babcock & Wilcox Co.
- Tubing & Fittings......16 p. covers installation accessories for lubrication, hydraulic, steam, liquid & air applications. Data, specifications & prices on tubing, tube fittings, hose, etc. Catalog No. 17-D.

 430F J. N. Fauver Co.
- Tubing Steels, Welding.....Outlines the welding characteristics of both austenitic & ferritic grades of stainless steels & discusses question of proper joint design. Describes various welding methods. TDC 162.

 4306

 Babcock & Wilcox Co.
- Tubing Troughs.....Describes complete system for permanent & continuous support of instrument tubing. All items & fittings in system are represented by photos & dimensional drawings. 12 p. Bulletin 254.

 439H Instrof, Inc.
- Valves.....Furnishes pertinent informa-tion on line of cast steel valves ... for liquefied petroleum gas service. All valves described are disc valves, both single-seated and double seated. Bulletin No. 54-S.

 301

 Okadee Co.

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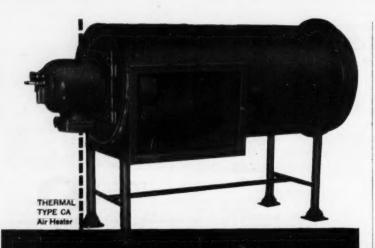


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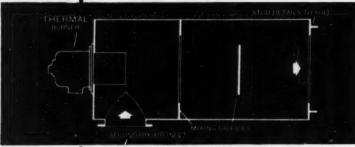
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FOR DETAILED INFORMATION WRITE FOR BULLETIN 104



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LITERATURE . . .

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1

Valves, Air Release..... Used to vent air from water or gas from any liquid in a pipe line or closed vessel. Includes description & method of operation, applications, types, etc. in Condensed Bulletin 654. V. D. Anderson Co.

Valves, Angle, Seal-Balanced.....Embody all the benefits of Venturifio design—corrosion-resistant retained seat ring, reduced turbulence, Venturi throat design, large flow capacity, etc. Bulletin 104-B.

Hammel-Dahl Co.

Valves, Blow-Off.....Provides information on Type "B" seatless blow-off valves with balanced sliding plunger. No seat to score, wear, clog, or leak. For pressures to 400 psi. Details in Bulletin No. B-426.
4320

Valves, Globe & Angle.....Describes
"500 Brinell" bronze globe & angle
valves. Seats & discs of cutlery grade.
true "500 Brinell" stainless steel, precision machined on specially designed
equipment. Bulletin 110.
432D Kennedy Valve Mfg. Co.

Valves, Lubricated Plug.....Cover variety of services for gasoline, oil, water, air, gas, acids, chemicals, etc. Includes characteristics of design, special features, & types, in 44 p. illustrated Catalog No. 5.

ACF Industries.

Valves, Lubricated Plug.....24 p. shows valves in full-port & venturi types, sizes up to 14", & with a choice of self-sealed 2-piece plug or 1-piece plug designs. Complete engineering data. Reference Book No. 39-5. 432F. Homestead Valve Mfg. Co.

Valves, Needle Control.....Explains design details & operating characteristics of line of needle-type valves...
engineered for applications requiring precise control of low rates of flow.
Bulletin 5C-13.

4326
Foxboro Co.

Valves, Porcelain.....Company makes available detailed literature covering the features and advantages of porcelain valves. Builetin includes complete description, characteristics, and specifications.

315 Lapp Insulator Co.

Valves, Reducing New line of reducing valves . . help solve small flow control problems. Includes information covering numerous features, capacities, specifications, applications, etc. Bulletin No. 511-A.

Leslie Co.

Valves, Relief.....Includes dimensions and design details for company line of forged steel strainers and relief valves, plus tips on the installation and maintenance of these products, in illustrated Catalog No. 12-T. 4321 Edwards Valves.

Valves, Solenoid.....Announces new compact two-way solenoid valves ... for controlling the flow of air, gas, water, light oil, and other noncorrosive fluids. Features, applications, dimensions, etc. Form 708.

4323 Automatic Switch Co.

Process Equipment

- Centrifugals, Automatic Recycling.....
 Roberts G-8 automatic recycling centrifugal provides large capacity—48" x 30" x 7" basket has a volumetric capacity of 15.7 cu. ft. Full details in Bulletin No. 5426.2.
 433A Western States Mach. Co.
- Centrifugals, Continuous.....Illustrated Bulletin describes application of con-tinuous centrifugal filters, listing 75 materials on which they are success-fully used, with specific examples of performance. 433B Bird Mach. Co.
- Centrifugals, Suspended..... Presents detailed information upon request covering company line of Suspended Centrifugals with Gyro-Balanced suspension head, & optional unloading & time control equipment.

 433C Bird Mach. Co.
- Centrifuges.....One of the numerous outstanding advantages offered by every Reineveld centrifuge is its deeper bowl ... which leads to greater filtering area & increased production. Request Booklet 5-RC-3.

 38 Heyl & Patterson.
- Classifiers, Continuous Centrifugal.....
 Company makes available descriptive
 literature on continuous centrifugal
 classifiers—what they do, how they
 work, with examples and pictures of
 successful applications.

 Bird Mach. Co.
- Crushers.....Supreme standard ma-chines for any material from soft wax and hard resins to sponge-iron. Ma-chines take 16 inch chunks and de-liver i inch size. Prices and free test run service included in Bulletin. 433E Franklin P. Miller & Son.
- Cyclones.....Valuable data on "hydrau-lic centrifuge" . . . used to thicken or classify slurry solids. Describes what it is, how developed and made. and how it works. Complete details in fully illustrated, 20 p. Heyl & Patterson.
- Demineralizers..... Describes entire line of water conditioning equipment and specialties. Covers demineralizers, hot process, hot lime zeolite, zeolite softeners, reactors, deaerators, filters, etc. Bulletin No. 6210.
- Demisters.....Literature describes how wire mesh sections improve perform-ance & increase the throughput canac-ity of any process vessel handling both liquid & vapor phase materials. Illustrated Bulletin No. 16. 433H Otto H. York Co.
- Discs. Frangible.....Individually-designed pressure relieving devices used to protect equipment or process systems wherever over-pressure is a problem. Illustrated Catalog Sheets cover variety of uses.

 4331 Frangible Discs.
- Filter-Driers.....Best protection for refrigerating systems against the harmful action of dirt, moisture, and acids. Includes dimensions. installation data, construction features, etc. Illustrated, 4 p.

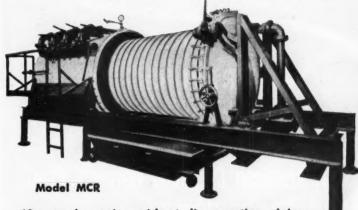
 A-P Controls Corp.
- Filters.....For cleaning hot, wet & corrosive gases & air. Includes variety of installation photos, engineering drawings of filter components & complete systems, & descriptive information, in 8 p. Bulletin No. 4.

 433K Mechanical Industries.
- Filters.....Covers line of fast action heavy duty filters . . . engineered & constructed for the ultimate in effi-cient, smooth performance. Offers data on features, capacities, etc. in illustrated Bulletin 501. 433L Sparkler Mfg. Co.

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1000 sq. ft. of Filtering Surface 2000 lb. Filter Cake The largest filter of it's type ever built



60 second opening without disconnecting piping. Available in sizes from 100 to 2000 sq. ft. of filtering area. Filter cake can be removed in a semi-dry state by hand scraping or in some cases merely tapping the plates to let the cake fall into the portable disposal receptical.

One man can handle the complete cleaning operation in ten minutes. One movement of a handle to release head bolts, a flip of a switch and the tank moves back, stopping automatically, exposing the plates in less than 60 seconds. Pipe connections are all in the stationary head, so no disconnecting of piping is required. This gives you the fastest action, time-saving, labor-saving tank opening ever engineered in a filter.

Jet pressure spray tubes can be supplied in this filter for washing off cake or in combination with backwashing when the material filtered and sewer conditions permit this type of cleaning.

Filter tanks can be supplied in mild steel, stainless steel, Hastelloy or other metals to meet requirements.

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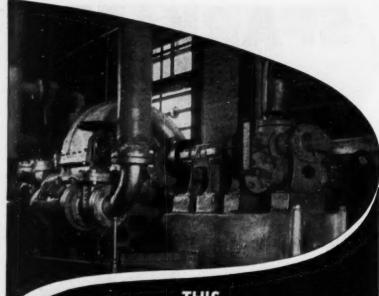
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G-2

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

LITERATURE . . .

Filters, Diatomite.....For water of highest clarity. Low in initial cost & available in complete range of sizes, with a choice of either monel, everdur or aloxite filter elements. Information in Bulletin 801.

434A Elgin-Refinite Div.

Filters, Pressure..... Describes extensive line of pressure filters & their accessories. Includes specifications, operating characteristics, outline dimensions, installation photos, etc. 16 p. Bulletin No. 2225-E. Permutit Co. 4348

Filters, Pressure Leaf.....For flow rates two to five times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Find complete details in new Catalog NC-1-53. 199

Filters, Pressure Leaf..... Supplies valuable literature outlining the design and construction advantages of new pressure filter. Also provides a table of filter sizes and capacities covering sixty-six models.

Bird Mach. Co.

Filters, Rotary Vacuum.....Covers design features... for handling both slow filtering & free filtering solids; how it discharges thin cake by pneumatic blow-back, & utilizes thorough counter-current wash.

Bird Mach. Co.

Homogenizer-Disperser....Only mill designed with the patented Triple-Action, Triple Angle Rotor-Stator combination. This & numerous other exclusive features described in fully illustrated, 16 p. Bulletin.

454E Tri-Homo Corp.

Mixers.....Agitation specialists show how their services can help you attain the desired goal in process agitation—highest efficiency at lowest outlay cost. Covers mixer line in illustrated Catalog No. B-105. 197a Mixing Equipment Co.

Mixers.....Mixers meet tremendous variety of fluid mixing needs. Includes valuable data on side entering mixers, top entering mixers, portable mixers, etc. Request four helpful catalogs—Catalog Series 17. 295a Eastern Industries.

Mixers.....Mix-Mullers for chemical and process industries. Covers Simpson mulling principle; mulling for dry, wetted and plastic mixtures; Mix-Mullers for special requirements; etc. 12 p. Bulletin No. 522.

484F National Engrg. Co.

Mixers.....Company makes available
Confidential Mixing Data Sheet. Helpful checklist enables you to develop a
complete technical description of agitation required for your process,
quickly & easily, No. B-107.
197b
Mixing Equipment Co.

Mixers, Laboratory.....Laboratory mixers: electric motor driven, direct drive, variable speed and geared models. Air motor driven models also available. Provides complete details in Bulletin No. DH-50.

197e Mixing Equipment Co.

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CONTROL OF **COMPLEX CHEMICAL CONTAMINANTS**

made simple with **MULTI-WASH COLLECTORS**

> Dust particles are removed from the air stream by impingement against wetted surfaces and through water curtain action. The constant change in direction of the air stream and its effect in creating turbulent action in the liquid serves to keep the inside collector surfaces clean. Effectiveness on both soluble and insoluble dusts is about the same

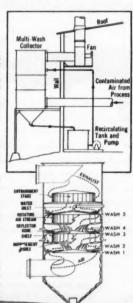
Pumes are also removed by impingement against the closely spaced turbine-like stationary vanes and flushed surfaces of the shell, deflectors and shelf plates. High collecting efficiency is obtainable even on sub-micron material.

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Soluble The intensive action of the air stream with the water curtains and spray patterns makes the Multi-Wash Collector very effective in the removal of soluble gases.

Many successful installations are in operation where the gaseous contaminant in the air stream is removed through chemical reaction with the recirculated liquid. For example, hydrogen sulphide, sulphur dioxide, hydrochroic or hydro-fluoric acid vapors will react readily with an alkaline solution. Some more complex odors can be removed or stabilized by means of an oxidizing chemical in the recirculated liquid.

Standard Multi-Wash Collectors are constructed of heavy plain carbon steel. Special units are constructed of various types of stainless steel, Monet, Inconel, Hastelloy, Haveg, copper or steel with special coatings to protect interior surfaces against corrosive action and assure long, efficient operation. Corresionresistant Construction



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Perhaps you need special design techniques — if you do, Whitlock can help you. For example, this ethane cascade condenser was carefully designed to operate with ethane condensing at minus 40°F. and 100 psi in the 16" dia, shell while Freon – 22 (at minus 55°F.) is fed to the tube circuit through 8 inlets. Whitlock Engineers are thoroughly experienced in designing exchangers for difficult operating conditions.



Perhaps you need an exchanger for elevated pressures like this feed-water heater with mono-bloc channel. This 18" dia. heater, the second in a series, heats 100,000 lbs. per hour of feedwater from 212° to 244°F, with steam at 16 psig. Design pressures are 75 psi and 700 psi on the shell and tube sides respectively and fabrication is in accordance with Paragraph U. 69 of the A.S.M.E. Code on the shell side and Paragraph U. 68 on the tube side. We are regularly manufacturing shell and tube units (for pressures to 3000 psig.) and shell and coil units (for pressures in excess of 5000 psig.).



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Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

LITERATURE . . .

- Mixers, Portable..... Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. No. B-108.

 197h Mixing Equipment Co.
- Mixers, Side Entering Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog B-104.

 197g Mixing Equipment Co.
- Mixers, Top Entering.....Makes available pertinent information on topentering mixers (propeller type) ... for closed tanks, pressure & vacuum ... for open & loose-covered tanks. Data in Catalog B-103.

 1971 Mixing Equipment Co.
- Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selections tables, etc. No. B-102.

 197e Mixing Equipment Co.
- Pelleters, Plastic.....Offer valuable features: enormous capacity; relatively small & compact; produce pellets uniform in size free from dust; cuts are clean & free from feathers; etc. 4 p. Index No. App. 210. 436A Taylor, Stiles & Co.
- Process Equipment Booklet contains advantages, operating characteristics and a description of automatic processing equipment for foamed and unfoamed polyurethanes and other multi-component resins.

 436B Applied Engrg. Assoc.
- Process Equipment.....20 p. Catalog reviews the entire line of chemical processing, food processing, fertilizer and fish reduction equipment. Introduces and features Dehydro-Mat. Illustrated Bulletin No. 854.

 436C Edw. Renneburg & Sons Co.
- Process Equipment.....Company makes available their new, completely illustrated Catalog on blending, processing, and heat exchange equipment for the chemical and processing industries. Bulletin No. 13.

 436D Patterson-Kelley Co.
- Screens, Vibrating.....Describes in detail two new expanded lines of vibrating screens. Feature drawings, tables, and numerous illustrations of Bonded screens in use. Request Bulletins Nos. 1986 and 1987.

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 436F Southwestern Engrg. Co.
- Separators, Centrifugal Centrifugal
 Separation Guide describes product—
 how it operates, the separations it
 accomplishes, its application in processing. Complete with numerous illustrations. Bulletin 5153.
 436G Merco Centrifugal Co.
- Separators, Centrifugal Illustrates & describes new centrifugal separating machine . . ideally suited to needs of the chemical industry. Includes advantages, features, & characteristics. Bulletin 5426.1.

 Western States Mach. Co.
- Separators, Centrifugal Furnishes upon request the "Merco Capacity Calculator"—a fast method to approximate the size Merco centrifuge required in your process. Describes Merco Rental Plan. Form 5409, 4361 Merco Centrifugal Co.

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438B Air Reduction Sales Co.

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8

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289 De Laval Steam Turbine Co.

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319 Allis-Chalmers Mfg. Co.

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438E Ingersoll-Rand Co.

Pumps, Proportioning......Describes new type proportioning pump with no packing, unique high speed valves and pulse free flow. Tells what it is, why designed, what it will do, how it works. Bulletin No. AP-54. 488F Hills-McCanna Co.

Pumps, Rubber-Lined.....Designed for handling abrasive, fine-mesh material —½ in. to 325 mesh—sand, taconite, grinding mill discharge, tallings, etc. Features & advantages in illustrated Bulletin 52B8156. 438G Allis-Chalmers Mfg. Co.

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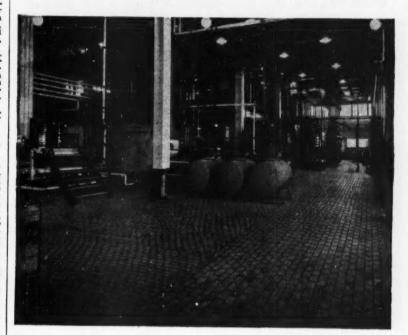
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439A Peerless Pump Div.

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Services, Processes, Misc.

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Clothing, Protective.....New Folder describes aluminized asbestos protective clothing...designed for industrial workers, truckers, firemen, etc. Swatches of material have been tipped on to front cover.

439E Ind. Safety Specialties

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439 Randolph Labs.

Gas Masks.....Company offers their valuable "Acme Protection Guide for Hazardous Gases"—a list of hazardous gases combined with a list of equipment recommended to protect against them. 6 p. Builetin 542. 439G Acme Protection Equipment.

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4391 Mine Safety Appliances Co.

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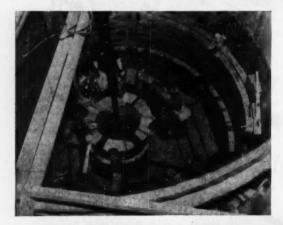
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Acid-Alkali-Proof Construction News

NATIONAL PETRO-CHEMICALS BRICKS IN AN ACID TANK



Chemsteel crews
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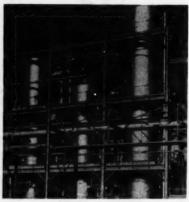
CHEMSTEEL EXPERIENCE ASSURES CORRECT ACID PROTECTION AT NATIONAL PETRO-CHEMICALS CORP.

When National Petro-Chemicals Corporation required acid protection for long-life, low-maintenance-cost operation of a Synthetic Ethanol Plant at Tuscola, Ill., the firm called on Chemsteel.

Recommendations accepted, Chemsteel lined the Acid Stripping Tower with carbon brick; installed ceramic nozzles; manhole sleeves; split bubble cap and sieve trays; and other equipment to protect the tower from hot sulfuric acid.

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For Small Sizes
MODEL PG
Pistol Grip
TUBE CLEANER



The fast, efficient Pistol Grip Tube Cleaner provides the operator with one-hand control for cleaning small, straight tubes. Weighs only 3 lbs—no more than a 12" Stillson wrench.

For Intermediate
Sizes
MODEL PGX
TUBE CLEANER



Positive drive (not geared down) high speed, rotary shaft, air-driven scavenger type cleaner. Washes out tube and debris as it cleans, keeping drill bit cool at the same time. For either vertical or horizontal applications, straight or curved tubes.

For Heavy-Duty Service MODEL TP-301

TUBE CLEANER

Suitable for vertical or horizontal use in straight or curved tubes 3/8" ID to 27/8" ID and up to 40' long. Cleans rapidly, thoroughly, operating at high speed at 90 psi. Can run on pressure as low as 50 psi.



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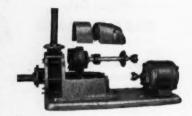


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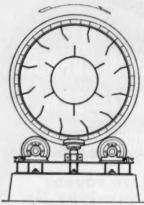
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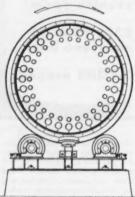
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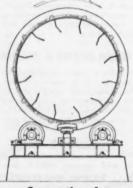
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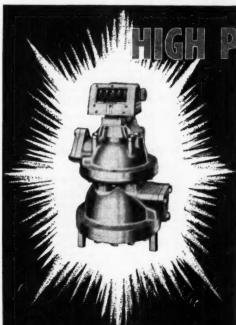
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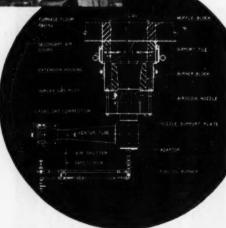
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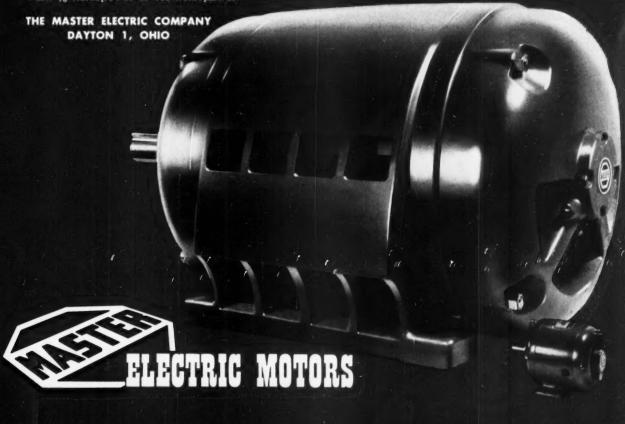
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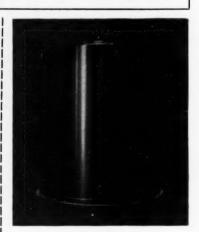
Glassed both sides, they won't rust, never need painting

NEW PRODUCTS TO HELP YOU FIGHT CORROSION



DRYER-BLENDER

New Pfaudler glassed steel conical dryer-blender permits drying corrosive products in as little as 1/5 time previously required. See story below.



UTILITANKS

Glassed inside and out with a mild corrosion resistant glass, these storage tanks are low first cost and easy to clean. See story at right.

These new low-priced Pfaudler UTILITANKS have a smooth, nonoxidizing glass surface inside and out.

On the inside, this glass protects your product from contamination because glass will not oxidize, flake or deteriorate with age.

On the outside, the glassed surface means you never have to paint the tank. It won't rust. Over the years, you'll save hundreds of dollars in upkeep costs.

Fast, Easy Washing

Cleaning is easy, too, because Pfaudler glass is smoother than the most highly polished stainless steel, and practically nothing sticks to it. Just hose it down.

Beneath these glassed surfaces is a rugged carbon steel tank which gives you the structural strength necessary for day-in, day-out use. The glass is not simply a coating or layer of enamel-it is actually fused to the steel in Pfaudler's furnaces at 1600° F. This results in a bond of interlocking glass and steel so strong that our tests could not separate them with a pull of over 1500 lbs./sq. in.

Low-Cost Storage

UTILITANKS are low in cost. We've left off fancy gadgets and used glass perfectly suited for such products as paint, wax, antifreeze, ink, liquid sugar, and other neutral products. Sizes range from 1000 to 5000 gallons, and your initial investment can run as low as 50¢ per gallon capacity.

You'll want to see Bulletin 916 which tells what products may be stored in UTILITANKS, what sizes are available, what they weigh and what features are provided as standard. Send for information today.

Solve Corrosion Problems

Get complete information on the aids available to help you solve corrosion problems. Write for "Buyer's Guide to Pfaudler equipment and services.

Pfaudler

THE PFAUDLER CO. ROCHESTER 3, N. Y.

New Glassed Steel Dryer-Blender Does 4 Days' Work in 7 Hours!

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For example, a large manufacturer recently began using one of these new dryers for a product containing acid halides. The new Pfaudler unit has reduced drying time of this highly corrosive product from 4 or 5 days to 6 or 7 hours!

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They saved most of the time previously spent in handling trays of vacuum tray dryers. Filling and emptying a Pfaudler conical dryer-blender is quick and easy. It has a 11/2-foot diameter opening for filling, and a single 8" discharge nozzle.

When in use, the dryer slowly revolves, tumbling its contents and quickly providing an evenly blended,

evenly dried product.

To speed the process, heat is applied throughout the jacket by hot water, vacuum steam or pressure steam, and a vacuum exhaust constantly draws off vapors.

Freedom of Use

You can use Pfaudler conical dryers for every acid except hydrofluoric, and for alkalies up to pH 12 at 212° F. Thus you get the same flexibility you are already familiar with in Pfaudler glassed steel reactors, heat exchangers, columns and other equipment for tough corrosion jobs.

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Write us for further details about fast moisture-removal with Pfaudler conical dryer-blender.